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ENERGY AND WATER DEVELOPMENT APPROPRIATIONS FOR 1991

HEARINGS

BEFORE A

SUBCOMMITTEE OF THE

COMMITTEE ON APPROPRIATIONS

HOUSE OF REPRESENTATIVES

ONE HUNDRED FIRST CONGRESS

SECOND SESSION

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT

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ENERGY AND WATER DEVELOPMENT APPROPRIATIONS FOR 1991

MONDAY, MARCH 5, 1990.

U.S. DEPARTMENT OF ENERGY

SECRETARY OF ENERGY

WITNESSES

ADM. JAMES D. WATKINS, SECRETARY OF ENERGY

ELIZABETH E. SMEDLEY, CONTROLLER

DR. JAMES F. DECKER, ACTING DIRECTOR, OFFICE OF ENERGY RESEARCH

Mr. BEVILL. The committee will come to order.

Mr. Secretary, we are delighted to have you with us here this morning. This is your second appearance before the Committee, but the first time on your full budget of the Department of Energy. So, we are looking forward to hearing from you, and as is custom, we will put your most outstanding biographical sketch in the record.

So, you may just proceed as you wish.

Secretary WATKINS. Thank you, Mr. Chairman.

Mr. BEVILL. Your prepared statement will be made a part of the record, and you may summarize or do as you wish on it.

OPENING STATEMENT

Secretary WATKINS. I thank you very much.

Mr. Chairman and members of the committee, I am pleased to appear before you today to present an overview of the Department of Energy's Fiscal Year 1991 budget request. This is the first budget prepared entirely by the Bush Administration, and it reflects new approaches in a number of technology areas as well as a new appreciation of the costs of past neglect.

The Fiscal Year 1991 budget request for the Department of Energy is $17.5 billion, an increase of 6.4 percent over the Fiscal Year 1990 level. I would now like to highlight several of the more important programs and initiatives included in this budget.

FIVE-YEAR PLAN

Managing facilities in an environmentally sound manner and restoring environmentally damaged sites are the highest priorities in the Department. Safe disposal of nuclear, hazardous, and mixed waste, and protecting worker and public health and safety are important objectives for the Department and for the Nation. The En-

vironmental Restoration and Waste Management Five-Year Plan is the cornerstone of the Department's long-term strategy to vigorously manage DOE's cleanup activities.

An Office of Environmental Restoration and Waste Management has been established to manage and direct Five-Year Plan activities.

The estimated cost identified by the Five-Year Plan is $19 billion for Fiscal Years 1990–1995 for completing the highest priority activities, in addition to $700 million for uranium enrichment cleanup. The $2.8 billion budget request for Fiscal Year 1991 will fund Five-Year Plan activities necessary to prevent near-term adverse safety and environmental impacts and promote compliance with existing agreements and implement standards and permit actions that could reduce risks or costs.

NUCLEAR WASTE DISPOSAL

Nuclear waste disposal is another priority of the Department. The program is structured around a three-point plan I announced last year. The plan centers on restructuring the Office of Civilian Radioactive Waste Management, initiatives to gain access to the Yucca Mountain site to continue the scientific investigations needed to evaluate the site suitability for a repository, and an initiative for establishing an integrated Monitored Retrievable Storage facility to begin spent fuel acceptance in 1998.

The fiscal year 1991 Nuclear Waste Fund budget request of $292.8 million provides for continuation of this three-point program.

CONSERVATION AND RENEWABLES

In fiscal year 1991, our commitment to conservation and renewables research and development is reflected in the 8 percent budget increase over the Fiscal Year 1990 appropriation, and the 78 percent increase over the Fiscal Year 1990 request. The Fiscal Year 1991 budget request for Conservation Research and Development alone is more than twice the Fiscal Year 1990 request, and reflects the new priority the Department is according energy conservation. Using energy more efficiently and developing cost-competitive renewable energy will contribute to both a better environment and to reduced U.S. oil imports.

The Fiscal Year 1991 budget request is also in line with recently announced Fiscal Year 1990 initiatives to increase energy efficiency and the use of renewable energy sources. These initiatives are intended to demonstrate what can be done to reduce production of so-called greenhouse gases and should result in energy savings.

NUCLEAR ENERGY

In nuclear energy, the budget supports development of advanced light water reactors, LWRs, including smaller, 600 MWe, advanced LWRs with passive safety features, which can be built more quickly and cheaply and which better fit the incremental capacity needs of some utilities.

The advanced reactor research and development program will continue to work on modular high temperature gas-cooled reactors, MHTGRs, and advanced liquid metal reactors, ALMRs.

An important new initiative will confirm the ability of an LMR, using the IFR concept, to burn up the long-lived waste products in spent commercial light water reactor fuel. If successful, it could greatly reduce the requirements for long-term storage of nuclear waste after the turn of the century.

The Fiscal Year 1991 budget assumed commencement of close-out of the Fast Flux Test Reactor, FFTF, in April 1990, following Congressional approval. Operation of the FFTF costs about 100 to $115 million per year. Its continued operation would require identification of a long-term mission, which is not apparent. We examined various missions, including Pu-238 production, but none of these were deemed to be a cost-effective use of the FFTF.

CLEAN COAL TECHNOLOGY

The total Fiscal Year 1991 budget request for clean coal technology, including advance appropriations enacted in prior years, is $456 million. This will complete the funding for projects selected in Round 2, $200 million, and Round 3, $156 million, and will provide $100 million for initial funding of Round 4 of the five-round program.

The budget request also includes advance appropriations to become available in Fiscal Year 1992–1994 to fund the remainder of Round 4 and all of Round 5, which will complete funding for this major initiative. Industrial cost-sharing in the 39 projects that are currently part of the clean coal technology program has exceeded 60 percent.

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

The budget request for Fossil Energy Research and Development programs is almost 20 percent higher than the Fiscal Year 1990 request. This request is based on the need to place Federal spending in the context of fiscal constraints, and to focus expenditures on those projects which industry is unlikely to support without assistance.

Improved liquid and gaseous fuels extraction technologies are essential to increase domestic oil and gas supplies. A major new item in our Fossil Energy Research and Development budget is a $17 million geoscience initiative to support a regional/reservoir research program that will be jointly funded with consortia of States, industry and universities.

POWER MARKETING ADMINISTRATIONS

The President's budget proposes to make the Power Marketing Administrations, PMAs, operate in a more business-like manner through payment reform. The budget also proposes the sale of the Alaska Power Administration and the sale of the Georgia-Alabama system of the Southeastern Power Administration.

URANIUM ENRICHMENT

The Department continues to support legislation to create a government corporation to manage the uranium enrichment enterprise. We believe it is the best way to meet aggressive foreign competition in enrichment services.

BASIC RESEARCH

Maintaining scientific and technological preeminence is key to this Nation's ability to compete in the increasingly competitive world economy. Our support for basic research and development in such areas as High Energy and Nuclear Physics, Basic Energy Sciences, Biological and Environmental Research, and construction of the Superconducting Super Collider is essential to our future prosperity.

The Department's budgets for science and technology programs in the "Fortifying Foundations" category show increases across all major program elements.

SUPERCONDUCTING SUPER COLLIDER

Funding of $318 million is requested in fiscal year 1991 for the Superconducting Super Collider, SSC, a proton-proton collider having an energy of 20 TeV per beam that will permit exploration of this new domain of physics research which cannot be reached by any other facility either in existence or planned.

The SSC is a critical part of the Administration's initiative to strengthen the Nation's position as a world leader in science. Our support for the SSC does not mean diminished support for other, smaller science projects. As mentioned above, all of the Department's major science programs are receiving increases in the fiscal year 1991 request.

The most recent review by the SSC Laboratory has identified cost increases. Consequently, the project cost, scope and schedule are now under review. We plan to build the SSC to the full power level originally proposed, 20 TeV per beam, so we will be studying these cost issues very carefully. In a project of this size, some cost escalation seems inevitable, but the Administration's commitment to the project remains strong.

HUMAN GENOME

Programs of major importance within biological and environmental research are the human genome project and the global climate change project; $46 million and $66 million respectively, and our work is closely coordinated with other elements of the government.

SCIENTIFIC EDUCATION

One of the most serious educational problems facing the Nation is the declining number of young Americans, including women and minorities, pursuing careers in science and engineering. As a major employer of technically-proficient people, the Department has a major responsibility to ensure that the Nation's science education system is capable of meeting future requirements for manpower

that can both extend the frontiers of science and manage increasingly demanding technology.

The fiscal year 1991 budget request of $35 million for university and science education and the related university research instrumentation program, includes support for expanded pre-college science education initiatives developed at the Berkeley Conference on Mathematics and Science Education, and involves the Department's National Laboratories in local, State, regional and national partnerships directed at improving pre-college science education.

NATIONAL DEFENSE

The Department of Energy contributes to national security through its defense programs and through certain non-defense activities which assure the Nation's preparedness for potential energy emergencies.

The budget for our defense programs, including Naval reactors, is $8.5 billion, up from $7.7 billion in Fiscal Year 1990. Of this increased funding, $500 million is required in Fiscal Year 1991 to continue the intensive efforts begun in Fiscal Year 1990 on critical operations improvements throughout the defense complex, particularly at the Savannah River Site and the Rocky Flats Plant.

A significant change in our Nuclear Materials Production program is the decision not to build the Special Isotope Separation, SIS, facility, and to bring this research and development program to an orderly conclusion, completing ongoing experiments and documenting results.

Other sources of plutonium are currently available, and Departmental priorities are changing. Consequently, the construction of additional plutonium production capacity as a contingency is not warranted.

By contrast, our need for a source of supply for tritium remains critically important. A substantial portion of the defense budget is for improvements to reactor hardware, procedures, training, management systems and practices and maintenance, so that we can resume reactor production of tritium as soon as improvements can be made to ensure safe and reliable operation of the Savannah River reactors.

NEW PRODUCTION REACTORS

Looking to the future, the new production reactor program continues to pursue two preferred reactor technologies and sites for new tritium production capacity: A heavy water reactor at Savannah River and a modular high-temperature gas-cooled reactor at the Idaho National Engineering Laboratory. The Fiscal Year 1991 budget request for new production reactors is $363 million.

NAVAL PETROLEUM RESERVES

The Administration no longer is proposing to sell the Federal interest in the Elk Hills and Teapot Dome reserves, but has a new proposal that may prove more acceptable to Congress.

Under this proposal, the fields would be leased competitively, with competition to be expressed in terms of the royalty rate bidders would be willing to pay the Federal Government after also

paying a lease bonus of $1.6 billion, $1 billion of which would be paid at the end of Fiscal Year 1991.

To ensure that the Department of Defense has a secure source of oil after NPR-1 is leased, the proposal provides for the creation of a 10-million-barrel defense petroleum inventory to be stored in a cavern at the strategic petroleum reserve, and filling it with oil over a five-year period beginning in Fiscal Year 1992. The DPI cavern and oil fill will be funded from NPR lease royalty payments.

This proposal enhanced energy security and defense preparedness and reduces the Fiscal Year 1991 deficit by $1 billion. Draft legislation to permit and authorize the proposed leasing arrangement will be transmitted to the Congress shortly.

STRATEGIC PETROLEUM RESERVES

The Fiscal Year 1991 budget request proposes the continued development of the SPR on a schedule to achieve the full 750 million barrels of storage capacity by the end of Fiscal Year 1991, capable of fill by the end of Fiscal Year 1992, and the continued implementation of the ongoing program to increase drawdown capability to 4.5 million barrels per day. The budget also proposes to fill the SPR at a rate of approximately 59,000 barrels a day in Fiscal Year 1991.

The legislation authorizing the SPR program expires in April 1990. The Department is preparing recommendations to extend the statutory authority and to increase the Department's drawdown flexibility in the event of a Presidential determination to use the reserve during a supply disruption.

A study mandated by Congress in 1989, on alternative methods of financing the SPR, was completed by the Department and transmitted to Congress on February 2. As a result of this study, the Department intends to seek discretionary authority to enter into negotiations with one or more major petroleum producers on a leasing arrangement for SPR oil.

Under an oil "lease" or "option" concept, the Federal Government would obtain control over the oil in the SPR, but without necessarily bearing the full cost of outright purchase. Our intention would be to implement these authorities within available budget resources, as set forth in the President's Fiscal Year 1991 budget.

At the request of the President, DOE also carried out an interagency study of SPR size. The results of this study, transmitted to Congress on February 2 concurrently with the financing alternative report, are that a 750-million-barrel SPR will provide the U.S. with substantial protection against reasonably foreseeable future disruptions.

These conclusions were reached after a comprehensive review of economic, foreign policy, energy security and strategic considerations by a policy-level steering group comprised of representatives of all Federal Departments and agencies with interest in the SPR.

CONSERVATION GRANTS

The budget proposes a major change to the conservation grants program.

We believe that in view of the substantial resources made available to these programs from oil overcharge funds distributed to the States, there is currently no need to provide direct Federal grants.

Instead, we are proposing incentive funding for the States through the Weatherization Assistance Program. A total of $15 million is requested for two initiatives: $5 million to stimulate innovative programmatic approaches, and $10 million to leverage non-governmental funding resources.

Another $15 million is being requested for oversight and monitoring of State use of oil overcharge funds. It is expected that the funding requirements will be offset by funds from the Petroleum Overcharge Distribution and Restitution Act, PODRA, declared excess by the Office of Hearings and Appeals.

STAFFING

Many of the Department's most important programs have been adversely affected by difficulties in attracting highly qualified people, particularly in critical areas such as environment, safety, defense, research, and contract management.

DOE is working closely with the Office of Personnel Management to develop legislation on a government-wide basis to establish a special salary structure for a limited number of very critical technical positions and to exempt a number of technical positions from the strictures of the "dual compensation" laws so that we might attract some highly qualified individuals to civilian Federal service.

Mr. Chairman, I believe the Department of Energy's fiscal year 1991 budget request is sound and strongly supports our energy, science and defense missions with a proper regard for the environment and for the health and safety of our workers and the citizens of the United States. I look forward to working with the Congress to achieve these objectives, and stand ready to answer any questions you may have.

[The statement of Admiral Watkins appears at the end of the hearing record.]

SUPERCONDUCTING SUPER COLLIDER

Mr. BEVILL. Thank you, Admiral, for your very fine presentation. Without objection, the committee will adopt the 10-minute rule; everyone will be limited to 10 minutes, and then on the next round take as much time as you wish. Hearing no objection, we will put that rule into effect.

Mr. Secretary, the committee is pleased to hear you take a strong stand on a number of difficult issues. I am extremely interested in your initiatives in the following areas: Waste management, solar and renewables, education, defense facility cleanup, review teams and boards, Savannah River and Rocky Flats restart, SIS redirection, and child care centers.

There has been a great deal of discussion about the changes to the design of the SSC and the revision to the cost. I would appreciate it if you would update the committee on those two items.

Secretary WATKINS. Mr. Chairman, after coming into the Department, I felt it was important—particularly since the SSC was high on the President's agenda, in fact it has been made one of the

three major budget objectives for my Department by the Office of Management and Budget for the President—that we needed to take a very hard look to understand the physics changes that were being rumored about—here and elsewhere, in Dallas and, in fact, around the world—that simply putting in a one TeV injector and the four centimeter aperture for stabilization of the beam wasn't going to be enough.

There were many people who felt it wouldn't be enough at the time the initial cost proposals and estimates were made, but for whatever reason, it came forward as a one TeV injection and a four centimeter aperture holding to the proton-proton interaction energy.

I felt it was important to have the high-energy physics panel be brought together with objective and highly-respected minds in this field, and we did that. I think we had an excellent panel called the HEPAP, High-Energy Physics Advisory Panel.

I had a presentation not too many months ago, and I was impressed by the quality of the analysis and the unanimity in this group that in order to achieve the objectives and having learned these things only within the four years since the Super Collider was first outlined to Congress in 1986, that there were necessary changes to be made. The excitement of this group was much higher than I had anticipated, because I had heard a lot of rumors from scientists that this was taking money away from others and couldn't we use it better in basic science? We run into all of this cost escalation anyway.

But I think the excitement of this group in pinning down the necessity for 20 TeV, which requires a 10-to-1 multiplier in the energy of the injector, from two to 20, was something we should have bought off on in the first place.

This ability of the beam is very important so that we don't set up high risks in such an important feature as the aperture width of the beam itself. So, going from four to five is a significant change.

So, these two things alone, injection, energy and aperture change resulted in something on the order of $1 to $2 billion or higher cost escalation. Some of this information was only known to physicists within the year before the HEPAP made its report.

So, I think that these are important changes. I think they are legitimate changes. I think the excitement of SSC is greater than I would have anticipated, because of the work on this highly respected panel with Nobel laureates and the like.

Now, my job is to take that information and convert it to program cost schedule and expected contractual performance. That has not been done yet. We are in the process and intensive effort now to get our management act together so that you can be proud up here that we have a program management approach to this which is better than the track record DOE has had in the past. That is under way now.

We believe today we have identified the DOE project officer to be on station at Dallas. We have recruited and have names now and are doing the final work to get our program manager in DOE who will have full-time dedication to this task and has brought on major hardware acquisition in the past with success, and we are working with URA in Texas to pick that program manager down

there under the URA auspices so that we can deal right beside the scientists in cost schedule and performance.

This is where we have not done well in the past and that is our primary focus now, as we begin to launch off on serious international negotiations. Now we have pinned down the parameters, I might say the footprint of the Collider. So that is where we are today.

It has been a slow start, but with something of this nature now going between $1 and $2 billion above the $5.9 billion initially told Congress. You told me when I first came around, Mr. Chairman, to talk to you, that you were very sure that we were undercosting that thing. It was going to be more than that, I would be coming back to you next year and telling you that, and so you were a visionary, Mr. Chairman.

SSC COST ESCALATION

Mr. BEVILL. I hope I didn't give you the idea.

Secretary WATKINS. No, you didn't.

Mr. BEVILL. Admiral, don't feel bad about it, I have never known of a project under your jurisdictions to be overestimated. It is always underestimated.

Secretary WATKINS. We went back, Mr. Chairman, when you told me that, and we reviewed all Federal Government programs like this, and the average has been two and a half times the initial estimated cost. A lot of that is legitimate, because we are on the basic edge of research, and things are changing all the time.

We are in an explosive period in technology, and I do think it is legitimate on the first go and to make adjustments on the initial TeV, but I think now I need about six months, until June of this year, to confirm the figures that I can be proud about.

What I have done is embarked on two separate, independent cost analysis groups, totally independent of one another, that are going to be hard-nosed and look at the cost now. The peripheral costs are also significantly increased.

I would like to come up to you now with a budget that says for those parameters, this is what it is going to cost. Then, from that point on, perhaps take advantage of the 10-percent cost escalation over the 10-year life of the program, but not 10 percent at the front end, which is what we have been doing here essentially.

So, we have a lot of work to do to convince me that the schedule they have laid out is executable, and that we have the right talent in program management, both in my headquarters and down there in Dallas.

I have Dr. Jim Decker here, my Acting Director of Energy Research, to answer any further questions you might have in that regard. I believe we are on top of it now. We have advised the Congress of what we are doing in this whole SSC area, and we plan to keep you advised now as we get this program managership under control, and the cost figures in hand.

I will have to ask you to hold that off until June. What we do know is the $317.9 million that we have asked for the Super Collider in fiscal year 1991 still looks valid. Actually, as you know, we

came down from the initial projection of $392 million because of fact-of-life issues, some of which I outlined to you.

We didn't have our act together on the footprint, and we didn't put together a good cost analysis crew to harden the costs up. But the work is well laid out. We think it is solid. What we don't have well laid out is the future TPC of the program.

Mr. BEVILL. Actually, Admiral, with this cost review that you have going on, if we could get those figures by April, it would be very helpful. Dr. Decker, have you any comment on that? How close can we come?

Dr. DECKER. We can try to speed up our schedule, but I think getting them by April would be very difficult. I don't think we will have time for a good, independent cost estimate to be completed by that time.

Mr. BEVILL. We certainly want the most reliable figure you could give us. The Admiral testified that it is $1 to 2 billion increase due to changes in the design and so forth.

Secretary WATKINS. Just for the physics.

Mr. BEVILL. That is the total estimate? When we say $1 to 2 billion added to the original figure, which original figure are we talking about?

Dr. DECKER. We are talking about the 5.9.

Mr. BEVILL. All right. So we are saying now the $5.9 billion plus $1 to 2 billion more?

Dr. DECKER. We are in a range——

Secretary WATKINS. It will be of the order, as we have said, $1 to 2 billion more, but close to 7 or 8 at this point in time. The problem with putting a number out there is I don't want to give you a number now that isn't credible. I don't know if I can get good, independent cost analysis in this just from the scientists who want things. We have to have somebody else in there that knows what dollar ramps we can stand, and do we have the people on board to run the program?

That kind of thing has not been well integrated at this point.

Mr. BEVILL. We would like for you to keep us advised on the progress that is being made on the cost estimate. This is something the panel is interested in, of course.

Secretary WATKINS. We can commit to a report to you in April, Mr. Chairman, of where we stand, and if we have narrowed the scope down to give you at least a band of expectation on that. We will try to do that.

Mr. BEVILL. All right. I understand my 10 minutes are up, so I will be coming back.

The Chair recognizes Mr. Myers.

SUPERCONDUCTING SUPER COLLIDER

Mr. MYERS. Time really flies when you are having fun. Mr. Secretary, proceeding on SSC, as the chairman has said through the years, we have learned that the first estimates are almost always on the low side.

I expect they are still on the low side. You have increased from $5.9 billion to between $7 and $8 billion. It adds up pretty quick. One of the things that the critics have said to many members,

when we have had votes in the full committee and on the Floor, that there would be tremendous cost overruns and always the question what really is the American taxpayer going to get for his investment?

We have a lot of taxpayers out there having difficulty raising enough money to pay their taxes and feed their children and put shoes on them and send them to school. So, it is difficult for us to justify expenditure the size of $8 billion for something that is difficult for people to understand. Why do they need an SSC, especially if they are not from Texas.

Secretary WATKINS. Let me do the best I can on that, Mr. Myers. I think it is a very valid point, and a point that I raised with the High Energy Physics Advisory Panel. I wanted the scientists, really, the people who had the background and the international prestige to come forward and say why, in a simplistic way, and Dr. Decker can add to this. I would like to say it this way:

Einstein was confused by his inability to get a unified force theory that matched what he expected was really there. We are talking about the electromagnetic forces, the weak forces, the strong forces pull together in a context that tell us what we are, what is mass, how do we get mass.

We are going into space and looking at the very earliest times in the universe. Like 10 to the minus 15 seconds, this tells us what possibly happened out there, and what mass is all about. We are looking at the stars and black holes, listening to the radio frequencies and so forth.

What we are trying to do with the Super Collider is come at it from the other end, looking at the very fundamental particles of matter, the T-quarks and all of the funny things that came out since you and I went to school.

There is expectation by these experts that came in doing their calculations, that in the Super Collider at the 20 TeV level you must achieve that energy in order to find the answers to the remaining questions that Einstein had about what mass is all about, and how these forces permit a human being to exist.

If we can find the answers at this level and we can compare them with what we see in astrophysics and so forth, we have unlocked so many questions of the unknowns that are now plaguing us.

We don't know whether that will have applicability in superconducting materials or human genome projects. We know the spin-off will be incredible. We will maintain our lead in this area in the world, and to me, it is as exciting as going into space. To physics, this is the gutsy stuff that causes excitement among all of the physicists of the world.

I think that is why we are getting, at least the early indications, a willingness to participate on the foreign nations' part. They know that the accelerators can only take it up to the 5 or 6 TeV level. The breakoff point is 17 TeV. So, 20 TeV is clearly in the region that gives us the signal to noise ratios that you need when you get down to the infinitesimal point of time.

How important it is to the American people vis-a-vis poverty is very difficult. I handed out a handout there that I think will be interesting for the members. Please take a look at it. If you go back

into the very last diagram on there, you will see a chart here that says fiscal year 1991 budget, science.

In there are all of the elements of our science input in High Energy Physics, Basic Energy Sciences, Nuclear Physics, Biological and Environmental Research, and on top, there is the Super Collider.

The reason I think this graph is important to at least the American people and the scientists around the Nation and the world, is that we are not depriving ourselves of those basic elements of research that are so critical also. In fact, it is on top, as you can see with the orange-yellow hatched-in framework there on the Super Collider.

So, if we don't get the Super Collider, obviously those dollars would migrate elsewhere, whether it was a contribution to the elimination of the deficit or to other programs. Nevertheless, I would have to say that I think this is one of the most exciting things in fundamental physics going on in the world today. And I can only say that every time we have embarked on anything as fundamental as this out of things such as semiconductors, other things come.

The scientific spinoff will be overwhelming in the world. We will have major nations participating with us. I think the excitement is there, and I hope to make this a motivational scientific education center as well, to bring youngsters in the game to try to look at ourselves in this very fundamental way as we are trying to look at the phenomena in space that happened billions of years ago.

So, it is, to me, as exciting, as I say, as going into space, and from the high energy physics point of view.

Mr. MYERS. Mr. Secretary, I think every member of this subcommittee has supported the SSC, although some with reservations. The things you have said are fascinating, the black holes and the quarks. You have found the Z particle.

Secretary WATKINS. Yes, sir.

SSC: TEXAS CONTRIBUTIONS

Mr. MYERS. But most of our taxpayers aren't physicists and they have a hard time understanding. They say, how in the world can you support spending our money for something when you have no idea of what it is going to find or even if there is something out there that we need to know?

So, this is difficult, and I think this is the one thing that we haven't done a very good job of selling, and very frankly, I find myself inadequate to do it. The State of Texas is going to raise in the neighborhood of $1 billion towards the project.

Now, is that part of the $7 to $8 billion or is that in excess?

Secretary WATKINS. That is all part of it. Remember now, the initial formula proposed by the Administration and given to Congress at the $5.9 billion level was that one-third was going to come from non-Federal sources. This means in this case, the State of Texas and internationally; we arbitrarily split them about equal, and said $900 million from each one would be a reasonable breakout. $1 billion was committed by the State of Texas.

I met with Governor Clements on repeated occasions. They are about to go into their initial bond program to start the money flowing. They want to make $100 million of that available right away, as necessary to commence the job.

SSC: FOREIGN CONTRIBUTIONS

So, they are very serious about it. The foreign contribution we are just starting again now, having gone through the interagency process to prepare our international plan, which is approved and now has to be adjusted for the new physics reality that I talked about earlier.

We are about to get on the street and see what is in the realm of possibility there. We think probably around $1 billion is possible. Maybe we can do better than that. We are going to try our best. Then we are going to come back to this committee, to the chairman, and say we have been through the mill again internationally, here is the commitment from Texas, here is the final cost of what we are saying now is the right cost for this program, and see where we go from there.

I think I will probably have to have considerable debate within the Administration itself. This increase from $5.9 up a couple billion will take a lot of questioning, review in the Office of Management and Budget, with the staff and with the President.

So, this will all be part of the program to see whether or not the Nation is willing to make this kind of investment. I think at this point, I am going to be much stronger than I was a year ago, because I believe I know more about it now and know what is possible, having seen what we do in our laboratories. I have visited them all on some of the superconducting materials work that we are doing in high-energy superconductivity. Understanding that may be critical to understanding fusion and other matters that we don't know yet.

I am hopeful that we will have the same experience we classically have when we go into these fundamentally basic research modes that good things come from mankind, including medicine and every other field of science.

Mr. MYERS. Some of the urging in the past has been that we need to start the SSC construction so that we can have international cooperation and collaboration.

Now, we have had substantial construction funds approved in the past year, yet there has been no nation to come on board to help.

Secretary WATKINS. I think they are all waiting.

Mr. MYERS. I think we have to have something before we go to the Floor with this bill.

Secretary WATKINS. We will move out now to make our second round, you might say, on the international circuit consistent with the international plan, which has been approved by all the intergovernmental agencies. That has only been within the last month.

Everyone has agreed, yes, this is how you must approach this. So we want to get on the street and move so that by next summer, when we come back to you with these other costs, cost figures that are more accurate, we will have it in hand. We will give you the best information in April—saying here is our situation report. Here

is where we are going and here is how close we are now to making our estimates, and see what we will do. That will raise the whole issue of one-third of $5.9 billion being different than one-third of eight.

So we have to deal with what is possible out there and make the decision as to whether or not the Federal Government is willing to fund the difference between what is possible with international and with the Texas contribution, and what the final price tag really is.

Mr. MYERS. This committee will need it before summer. You and I have used my 10 minutes, and so I will come back and visit you again.

Mr. BEVILL. The Chair recognizes Mrs. Boggs.

SUPERCONDUCTING MAGNETS

Mrs. BOGGS. Thank you, Mr. Chairman, Mr. Secretary and Mrs. Smedley and Dr. Decker, it is nice to have you on board, glad to have you with us.

To pursue the superconductor and Super Collider issues, Admiral, of course this subcommittee has always supported international cooperation and collaboration to share in the costs and the benefits of the SSC program.

However, one of the most attractive areas to foreign participants is the production of superconducting magnets. This is also an important technology for American companies, because of the potential for new applications.

How do you see plans developing for foreign involvement in SSC, and will this be done in a manner that avoids exporting our investments in superconductivity and allows this new technology to mature and develop as part of the SSC program?

Secretary WATKINS. Mrs. Boggs, this is the most important element of the technology, as you know, to bring the SSC to fruition. Going from four centimeters to five centimeters aperture, for example, requires us to move out on a relook at the producibility of the magnets, and that is included in our budget for next year.

We will manufacture the first magnet ourselves. It will be about a meter long, but will have the five centimeter aperture this year as we have done in the U.S. We will then commence improving the magnets again as we have done out at the Fermi Lab with the new aperture size. They have to be hand-done at this point.

We will continue the producibility studies which we believe can be shown to produce the magnets in large quantity numbers, such as the eight to 10,000 that we need of varying sizes to complete the 54-mile ring.

I would like to ask Dr. Decker to give you an update on the specifics of where we see this coming out, U.S. magnets versus foreign. As you may know, we have foreign nations today who are probably as skilled or more skilled in magnet manufacturing than we are.

So, the technology transfer in this case may be more to the U.S. than the U.S. to offshore. So that is one thing we ought to make sure we understand. We want to produce as many magnets as we can in the U.S. for our own jobs, and for our own manufacturing capability.

But maybe Dr. Decker can give us some specifics on where you see this coming out in the final scheme of things.

Dr. DECKER. We do expect that foreign contributions to the SSC will be in-kind contributions. Countries will wish to provide us with components such as superconducting magnets or other parts of the accelerator.

We will be moving forward with a request for proposals to involve industry in the phase two of the magnet industrialization program here in the next month or two. It is certainly our desire to ensure that a substantial percentage of the magnets are produced here in the United States. I think that is very important.

NATIONAL ENERGY STRATEGY

Mrs. BOGGS. Thank you very much.

Admiral Watkins, although we know that as you have said in your statement, that the Department is a year away from completion of its national energy strategy study. Could you please tell us in what direction this effort is leading?

Secretary WATKINS. Yes, Mrs. Boggs. I am impressed by the results of 15 hearings, nearly 400 witnesses, and 1,000 papers have come to us on State energy policies, integrated resource planning, emphasis on efficiency, conservation, and renewables. So much so that this year in submitting our budget to the Congress we packaged our budget up for the first time in the context of the chapters that we can expect will emerge from the National Energy Strategy development.

We have already taken advantage of the common threads which are clearly out there right now. We are not going to have an emergency strategy unless we concentrate on renewables up front, that we have some major problems facing us in electrical generation capacity margins that simply aren't there. We used them up by the mid-eighties. We are not building big plants of any kind, but lots of small plants.

What will happen is we will wake up one morning with a lot of brownouts, particularly in the East. We have had problems even in the Southeast of the country. So we are using up our margins. We have to have something in the near term. It isn't a matter of a political selection of one thing or the other. It is a matter of necessity, in that we are finding that there is more potential for hydro. This Department gave up hydro years ago. It is run by FERC, not the Department of Energy in terms of policy setting or programs.

Frankly, we have let hydro down. We have a web of complicated regulations that preclude anybody from wanting to relicense a plant. It is out there today. We know how to use this power judiciously on the streams and rivers of the country, and to do it in an environmentally benign way and a technologically feasible way.

We have power on existing dams without any further damage to the environment. We need to get on to agriculture. We have been told that everywhere, that agriculture is a source of energy, and biomass is critical to the Nation. In the Department, we gave that up some years ago after the oil prices dropped out from under us, and we threw out a lot of energy babies with the bath water at that time. We have to resurrect some of those.

Economics, how do we analyze all of this? How do we run an energy modeling system with energy sources? That is another common thread. All of these are coming through. We hope to have on the street by the second of April what we have called the interim report to Congress and the American people of what we found to date, what they are saying we need to do, what their options are, and what their obstacles to progress have proven to be.

I think you are going to find it fascinating that we could not do this sitting in Washington listening to all of the political agenda on one side of the aisle or the other. We had to get out and listen, and we found common threads that probably mean we can build consensus.

So you are going to see about seven or eight initiatives that we ought to be putting into effect right now and not wait. Everyone will agree, I think, on those, transfer of technology, taking the tremendous leverage from the nominal $150 billion of national investment in research every year, and leveraging back into our society to get the dollars we need to carry out the energy strategy itself.

So, it can be a self-supporting strategy. We will probably have to come back to Congress and ask for specific changes of law, streamlining issues that have to be addressed here and at the regulatory bodies at the Federal and State level.

That will be in the strategy. So, at any rate, it is a strategy that will be on the street at least for five months of public comment commencing the second of April. We will hold more hearings around the country and answer some of the questions. Get up here on the Hill, work harder with the committees such as this committee, to see what inputs you feel we should be making, hopefully leading to a submission to the President which will generally have significant concurrence nationally and here on the Hill by next year.

Then we want to update that biannually, consistent with our submission to Congress of an energy policy. That will mean continuing the hearing process; going out and sampling the waters out in the American public, which I find far more illuminating than we might get back here sitting on the seventh deck of the DOE in Washington.

OIL AND GAS DEPENDENCE

Mrs. BOGGS. That is a very exciting proposal, Admiral. But from the intelligence of the people, in and outside of the Beltway, who are engaged in energy policy, there apparently is going to be a short-term and a mid-term dependence on hydrocarbons such as petroleum and natural gas.

How are we going to meet the needs for additional hydrocarbon resources without increasing our dependence on foreign supplies? Do you think that maybe the Administration's Outer Continental Shelf policy reviews will deal with this problem?

Secretary WATKINS. I think in the first edition, our interim report, we are not ready to really face the tough and contentious issues of the interim strategy which I would assume to be essential as we steer away from dependence on oil. The imports will continue. It will go above the 60-percent by the end of the decade, but

perhaps in the policy we can begin to project in the future a turndown in that, and then a decline some time maybe around the year 2010 in terms of oil dependency as we find alternative fuels for transportation, which eats up two-thirds of our oil imports.

Then, as we look at the options that the American people are going to have to face if, in fact, the ANWR Range or additional offshore oil is not permitted to be drilled. So, I think what this strategy will provide is you can't have it all ways. You can be down on fossil and nuclear and then expect the Gross National Product to stay up.

So, we will have to face the music. You will be able to make your own excuse and say, if I give up this many barrels of oil here and this much natural gas, I have no choice but to import liquid natural gas. Am I willing to do that? Or I have to find alternatives, and what is realistic? Nuclear is not realistic for growth beyond the 110 plants we have today until after the turn of the century.

The same with very large coal-fired plants, except those that we are demonstrating. So, we are rather limited for the next 10 years at a minimum of what we can do without shooting ourselves in the economic foot.

That is the urgency. It is not just a document to waste our time and to put on the shelf. It is absolutely necessary that we have, so the American people can rationalize their positions they are taking on energy versus environment, and see if we are doing things in a scientifically and environmentally sound way.

Mrs. BOGGS. Thank you, Admiral.

I have been told that my 10 minutes are up.

Mr. BEVILL. We are delighted to have our ranking minority member of the House Appropriations Committee, Mr. Conte, come in. Mrs. Smith tells me that she is yielding her time to you, Mr. Conte.

Mr. CONTE. I will try to be very brief, then. Thank you, Mr. Chairman. Thank you, Virginia. You are always so kind to me.

Good afternoon, Admiral. I said hello to you earlier, but you thought I was the elevator operator. I was the guy on the little cart.

Secretary WATKINS. I thought you wanted an interview.

SUPERCONDUCTING SUPER COLLIDER

Mr. CONTE. You really move fast. I want to thank you for joining us today. Everyone agrees that you have an enormous job to accomplish, but I am confident that we have the right man for the job. I wish you the best of luck in grappling with the very difficult, tough issues before the Department of Energy. I am pleased to offer whatever support and cooperation that I can give you.

Mr. Secretary, one of the main challenges facing the Department of Energy is the development of a superconducting super collider, a gigantic machine with 54 miles of tunnel and no practical application. In 1987, the total estimate for that cost was $4.5 billion. That price tag then jumped to $5.9 billion, so they tell me. That is all in one year.

Mr. MYERS. It went up before you came into the room, too.

Secretary WATKINS. It was 5.9 when I arrived. It is now one to $2 billion above that, and that is not very arcane.

Mr. CONTE. Okay.

How has the Department's support for the project been affected by these new cost estimates? We were led to believe last year that DOE support for the project depended a great deal on the Department's ability to control costs. Apparently, $5.9 billion was not the magic number defining the outer limits of an acceptable cost.

Is there any new magic number that we can get today?

Secretary WATKINS. No, sir, the chairman asked the same question. We are going to report to this committee by April where we stand on the two-track cost analysis group that are coming in to oversee these costs, two totally independent cost analysis groups, to make sure that when I come back to you within four months, I have the right figures, at least for the current physics package, which we believe now is solid for the long haul, but I don't have all those costs put together properly.

I have got to do that so we don't continue to come over here with these kinds of large jumps at the front end of the program. We want to stabilize it, and I think we can in four months. We will give you a report in April as to where we stand.

Mr. CONTE. Are there any outer limits? If it costs 10 or $15 billion more, will you say, hey, we just can't do this?

Secretary WATKINS. I think there is a limit. I don't know what it is. As I mentioned, we are going to have to debate this within the White House itself. I plan to do that in the very near future, telling them what we are doing, where we are going, and perhaps some of those kinds of bounds will be placed on it.

I do think that we have now reached the so-called footprint parameters of the two TeV injection energy and the five centimeter aperture from the old four. Those are significant physics changes, and they are the primary reason for the cost escalation.

This has only been known since the first of 1986. So, there are some legitimate things that we have learned because of our understanding. I think the other costs going up are not so—I can't explain them as well. There will be some additional ancillary costs to those figures such as labor rates.

Mr. CONTE. What were the labor rates used in 1986?

Secretary WATKINS. They were the low end of the scale. There may be a $380 million escalation just in labor rate adjustments over the cost of the program. So, these are the kinds of things that I need to get a new, independent handle on.

I just don't trust the figures. I would not want to come up here again and play games with the committee.

SSC FOREIGN PARTICIPATION

Mr. CONTE. Admiral, did the appropriations that we appropriated last year leverage any foreign participation?

Secretary WATKINS. Yes, sir. We have $318 million in this year's budget, and we don't see cost escalation changing any of that. It will be, do we have the will and the desire as a Nation to build a supercollider? I think we are going down the path to do that.

In the meantime, certainly before the end of this legislative year and hopefully by June, you will have more accurate figures, and we can make a reassessment of where this fits in the total national scheme of things.

I think it is supportable and the right thing to do conceptually, but if it runs way off the target of cost, we will have to rethink it.

Mr. CONTE. You didn't tell me how much—

Secretary WATKINS. Congress has asked us to have one-third contribution from non-Federal. If we divided it up equally, say $900 million from foreign, $900 million from the State of Texas, with $1 billion having been committed by the State of Texas, that leaves us $800 million on the other side based on the $5.9 figure.

One-third of $5.9 is different than one-third of $5.9 plus $2 billion. Whether we can actually leverage beyond the nominal $1 billion in foreign investment, I am not sure at this point. It will be pretty much in-kind and depend on whether we want over 50 percent of our magnets produced in this country of the some 12,000 magnets that we will need on that ring, then the in-kind contributions will be defined by that parameter.

So, those are the kinds of things we will have to revisit and discuss with you. We hope to be able to do that in June, if you can hold off that long.

SSC: TEXAS CONTRIBUTIONS

Mr. CONTE. How about the State of Texas?

Secretary WATKINS. $1 billion. They are just about to announce their bond program down there. They are serious about it and committed to it.

Mr. CONTE. Is there a schedule of payments?

Secretary WATKINS. They are willing to put $100 million in right away to help us get it going. We have to make the broader review of this, and the commitment that this is what we want to do. We are a few months away from that yet, because of the cost escalations.

SSC SITE SUITABILITY

Mr. CONTE. Is it right to say that the SSC is undergoing major redesign, and how can the Department be sure that the proposed site continues to be the best site for the project?

Secretary WATKINS. Maybe I could ask Dr. Decker? My feeling is that it is the right site. The chalk is ideal at the level of a couple of hundred feet underground to go around that ring. It is the best site we have found, it was 53 miles, as you recall before. We haven't changed that much to 54 miles. We have the right alleyways for the scientists to work off the ring.

Those are all pinned down. I think that we are just about ready to announce the footprint now, and confirm that this is it. My biggest problem is to make sure that everybody agrees that we still have a program, that these threats of escalation up to one and $2 billion are not throwing us off track before we really harden up our program managership.

We are doing all of that in parallel. I hope we will be able to carry through on the project next year.

Dr. Decker?

Dr. DECKER. The technical design changes in the project have not changed the nature of it in such a way that we would revisit the site issue. The ring size has changed to 54 miles, but the basic facility has not changed.

Mr. CONTE. Admiral, I have many, many more questions. I will submit them for the record, and you can answer them.

Mr. CONTE. I want to thank the chairman for his graciousness and kindness and the ranking member and Virginia for giving me this time. Thank you. You are wonderful.

Mr. BEVILL. The Chair will recognize Mrs. Smith at this time.

Mrs. SMITH OF NEBRASKA. I thank you very much, and welcome, Admiral. This is your second appearance before the committee, and I want to congratulate you on the upbeat articles about the Department of Energy, about your job. Not many Cabinet officials have been treated so kindly by The Washington Post and some other publications.

Secretary WATKINS. Some people would say that is not a compliment, Mrs. Smith.

HYDROPOWER

Mrs. SMITH OF NEBRASKA. Also, what you have been saying about your interest in some fuels that have been dropped in the past, like ethanol, is music to my ears.

Now, first, let me ask you a brief question about the drought. You know that we are fearfully approaching our fourth year of drought in the West. One of the folks here the other day said it would take six years of normal rainfall to replenish the mainstream reservoirs on the Missouri River.

What are your comments about the effect this may have on the generation of hydropower and what has the DOE in mind to alleviate additional costs?

Secretary WATKINS. It is at the focal point of our discussion in our hearings on the potential of hydro. It is very much a part of it. We can assure that we are going to make an initiative to build up the interest in hydro energy within the Department of Energy, which by the way is almost totally dissipated; we just don't have anybody there working the hydro issue. So, we have allowed the regulators to do it, and they have probably done it piecemeal, and it is a rat's maze now of regulatory restrictions.

So, we are very interested in at least cleaning up that debris and opening the door for expansion of power at the existing projects, where we now have power generators.

Now, you raised the issue, are you going to be able to drive the turbines? So, we are in the middle of taking a look now, in addition to what we looked at for the theoretical hydro expansion on the existing dams, at where we already have power generators, whether or not we are building something that we can't drive.

I just don't have the answer to that. I wish we did. But our projects are not all that good. They change so drastically from one year to the next that we are worried about it. We cannot assume, particularly in those areas of drought, that we will not have some diminution in our outlook.

But I believe the 10,000 megawatts that I gave you earlier as being potential hydro power in renewables that could offset building fossil or nuclear plants is still possible. It does take into account some of those concerns on nature, and what they do to fill our reservoirs.

HYDRO RELICENSING

Mrs. SMITH OF NEBRASKA. Another question closely related. It has come to my attention that relicensing these facilities has become a real nightmare. Since 1987, we have spent $8 million out in the central Nebraska area district, and we still don't have a long-term license. Is this typical of the FERC relicensing cost?

Secretary WATKINS. It is typical. We had a presentation in the hearings, and the obstacles to relicensing alone would cover that entire wall to about 12 feel tall. The things that you have to go through. It is a nightmare, so even relicensing existing plants is so difficult with such a long lead time, that investors don't want to invest any more. They say, let's close it up. This is something that we can single out. I have talked to others about this. I think there is a lot we can do there. We just haven't really faced that whole issue for so long. It is almost as if we have written off hydro as if that isn't a contribution anymore. That has peaked out. We don't do that anymore.

Well, I think that it is too soon to say that. I think there is a lot more there. It is very precious, and it can be an environmentally benign source if we use modern technology for the fish ladders and oxygenation of water and all the things that you have to worry about so your wetlands don't get diminished.

In many cases, we can help wetlands, so we think this is a fruitful area, along with agriculture. But regulation is probably the biggest bar today.

Mrs. SMITH OF NEBRASKA. I have a list of other questions in that area. But I will submit them for the record.

PMA REPAYMENT REFORM

Mrs. SMITH OF NEBRASKA. I note that you brought back your perennial proposal to restructure the Power Marketing Administrations, and also to sell off the Alaska Power Market Authorities. It seems to me that this is just the same old plan that has been put forth in the last six or seven years. It will greatly increase the cost of energy.

You know, last year, I asked you to put in the record the increase in cost in some of the towns in my district. The cost increases were in the neighborhood of 40 percent. Now, have you transmitted proposed legislative language to the Congress to accomplish this restructuring? Does it include the calculation of what you mean by current market interest rates?

Secretary WATKINS. Well, it is not only the same proposal that we had last year, Mrs. Smith, we have a $1 billion potential revenue source in the $4.6 billion that we could obtain over a five-year period.

The Administration strongly believes that the existing repayment terms on PMA-appropriated debt amount to a subsidy for the

PMA customers at the taxpayers' expense. The repayment initiatives were first proposed in fiscal year 1986, and, except 1989, every year since.

I testified that the Administration would not implement any repayment reform administratively. We do intend to come forward with our legislative proposal. We have looked at the cost impact. The percentage increase, as you quoted, are quite right for your area. However, the estimated retail rate impact could be as low as down around 8 percent in the Bonneville Power Administration area. Wholesale would be much higher.

Mrs. SMITH OF NEBRASKA. Last year, you agreed then not to put this into effect administratively. Do you continue to pledge not to move without Congressional action?

Secretary WATKINS. Yes, I have enough problems at Rocky Flats, Mrs. Smith.

Mrs. SMITH OF NEBRASKA. Thank you. We appreciate your help.

Mr. BEVILL. The Chair now recognizes Mr. Pursell.

Mr. PURSELL. Thank you, Mr. Chairman.

I read that outstanding article in the New York Times Magazine concerning some of your problems. Now that you have been here a year, Admiral, as an old infantry officer myself, what one decision could you make today, if you had a rubber stamp "Congress", and a President's ear, to improve energy problems of this Nation.

IMPROVING SCIENCE EDUCATION

Secretary WATKINS. I would have to say the most important initiative is embodied in the six national goals set by the Governor and President in education. We have a scientifically illiterate Nation. It is a shame. We are supposed to be the best internationally.

We have absolutely superb laboratories and the best research work in the country, some of the best minds. We should be on the leading edge, and yet somehow we can't come to grips with our own risk assessments and the transfer of technology. We are losing out. We have to get our act together.

I think it comes from the lack of education. The other day, we had a situation in one of our places where the headlines were, "There is Uranium in the Wild Asparagus." That is the bad news. The good news is that you would have to eat—the second day, when the analysis was done, you had to eat 5,000 metric tons of this asparagus per year for 50 years to get the dose of one trip to Aspen skiing.

So, somehow we have to find out what is wheat and chaff in our mind, and give information to the American people, to a schooling system that puts out a product that is useful to themselves and society, and to explain some of these things so we can balance the pluses and minuses.

How do we balance environment and energy to keep the Nation on its feet and competitive? With scientific underpinnings that are solid. How do we understand high energy physics or science where we don't have a product delivered directly, but we know indirectly we gain tremendously such as we did on the trip to the moon.

Mr. PURSELL. You were at the Berkeley Conference. I know you want to budget money for pre-college science——

SCIENCE AND MATHEMATICS INITIATIVES

Secretary WATKINS. We have about $5 million more in our request from last year, up to about $35 million for total education. We will ask you for reprogramming in the next few days of a few million in 1990 to start ramping up in the area of pre-college science and math.

We have a tremendous number of initiatives we are embarking on as a result of the conference. We are bringing the scientists in our lab. We want them to volunteer to help the teachers and kids. We want them to reach down and help tutor youngsters.

We want to focus on minorities and young women who are, in many cases, rejected from these fields because somehow, over the years, we disallowed them from coming into these curricula. We want to be a model for math and science literacy, for math and science education, for vocations in the field, at the technician level, and others.

I think it is the most important thing we can do. It is not for the long haul. It is very nearly near-term.

Mr. PURSELL. As a former teacher and businessman, I would agree with you 100 percent. I was looking at a study done by the University of Michigan the other day comparing U.S. first-grade math and science students to Taiwanese and Japanese. We did pretty well in the first grade. When we got to the fifth grade, we ended up in third place. I really think our emphasis should be not only in college and in the high schools, but also in the grade schools.

There are good teachers in the elementary schools, but they have a different background and aren't really science-oriented.

WOMEN AND MINORITIES IN SCIENCE

Secretary WATKINS. We have done it almost by policy, Mr. Pursell. The University of Illinois has done a study taking second-graders, giving them eight weeks of math and science education, then giving them a test. At the end of that test, they also gave that same test without the precursor course to a random group of eighth graders in junior high schools in the Chicago area.

The second-graders beat them five to one. Now, this tells me a lot of things, but certainly it tells us that we cannot write off half of our society as somehow being unable to do these things. We desperately need today, in the area of environmental technology and waste management, an unlimited number of hires. We can use everything we can get nationally, not just within DOE.

There are not enough schools out there. This is at the technician level. There is no reason not to motivate these kids, minorities and others. Certainly we need women in science and math who have in some cases almost been screened out by policy that obviously they don't want to come into these non-traditional areas. That is not true.

Some of our finest young scientists in the universities are women. I have met and talked with them, baccalaureate as well as doctoral level. So, we have a lot of work to do.

You asked me what is most important. I would say that is it.

Mr. PURSELL. Will this be part of your national policy?

Secretary WATKINS. I mentioned earlier, right out front, we have the national goals set by the Governors and the President. We need not hide behind it now. It is our turn to get in the action mode and start doing things, to get serious about using our resources, and our human resources as well, and to pick ourselves up by our bootstrap.

I believe our Nation will be ill-served if we don't take advantage of this unique opportunity now with the so-called Peace Dividend being debated. To take this high leveraged research, of which we have so much in our own Department, to turn back into our own economy to fund the very thing we are talking about.

I don't think we need a lot of dough from Congress. We need a lot of focus and leadership and attention. We need participation between the public and private entities coming together, as we have just done in Chicago with the Governor, with the Mayor, with the colleges, with our Fermi and Argonne labs, to get serious about this and set our own goals.

Mr. PURSELL. Would you consider proposing some kind of a comparable White House Conference on Science and Mathematics?

Secretary WATKINS. I think you will see in the future, the White House will be very early out of the starting blocks in this whole business on just what we can do to help in partnership with school-based organizations, with State leadership and so forth to carry out these national objectives.

I think that the objectives were essential to be laid on the table. They are achievable. We know what to do. We know what works. We just have to get on with it. Everywhere we have the competence to help and matter and so forth. We will have to do it and do a lot of volunteering.

We have held this conference, and they are all ready to go. They are already volunteering, physics programs at Fermi. We are ready to help out, and not just the best and brightest.

Mr. PURSELL. I attended a big seminar in Detroit. They have black students, young men and women at the junior high level, in a program sponsored by General Motors, Ford and Chrysler, and several universities trying to generate enthusiasm. We had a black workshop on the weekend to encourage those young students to look at engineering as a future career.

The program included taking extra classes in the evening and on the weekend, to get into college and to take courses that would lead to an engineering degree. Surprisingly, the room was full. There must have been 200 students there, with their mothers and fathers.

I thought it was quite an exceptional piece of work. The business community is sponsoring these kind of events all over the country.

Secretary WATKINS. It is interesting that you brought that up. Secretary Skinner apparently was there for some of the discussions with the automotive engineering people. They were very well aware of what we were doing, and applauded this new effort. But I think it will take that, and they were saying we are jumping in right now ourselves.

So, this is a key issue. I think a lot of other things will flow from this.

Mr. PURSELL. I want to thank the chairman and congratulate the Secretary for his national leadership in this field.

Thank you.

Mr. BEVILL. The Chair recognizes Mr. Chapman.

SSC MAGNET TECHNOLOGY

Mr. CHAPMAN. Thank you, Mr. Chairman.

Let me thank Admiral Watkins for his testimony today. I apologize that I missed a portion of the testimony but I did have an opportunity to review your testimony before I got here today.

Let me ask just a few questions. I understand that a lot of focus today has been on the SSC. Let me ask some questions, and to the extent that I might touch on matters that have been previously discussed, just make a notation of that, and we will move along.

What is the status, in your judgment, of the ability of the commercial sector to produce the superconducting magnets. What is the status of the magnet technology.

Secretary WATKINS. I touched on it briefly, but I think we can go into a little more detail on the technical aspects of it. We have proven the magnets at the four centimeter aperture; we have proven the magnets. The manufacturability of those magnets out in the commercial sector to generate some 10 to 12,000 is part of the continuing research program in our fiscal year 1991 budget. It was in the fiscal year 1990 budget and continues.

I would like to ask Dr. Decker what he thinks the risks are out there right now with the manufacturability of those magnets.

Dr. DECKER. Having talked with industry people, they believe that we do have a four centimeter design that, in fact, can be manufactured in quantity with some relatively minor changes. We are, of course, now talking about changing the aperture from four to five centimeters, so we have to now go back and build some five centimeter magnets. Five centimeter magnets are not new in a sense that bigger magnets have been built elsewhere.

The Tevatron magnets are 7.5 centimeters, and an accelerator in Germany also has larger radius. I think they are at least 7.5 centimeters. I think we have a good basis in the four centimeter magnets to go to five.

We don't anticipate any change in the concept, but rather, it is an engineering change.

Mr. CHAPMAN. Is there any technical reason that an increase in the aperture from four to five centimeters should create a new engineering challenge or is it just an upsizing of that magnet? Is moving from four to five creating a new R&D challenge that goes beyond the scope of just increasing size?

Dr. DECKER. Well, we certainly have to do some R&D. We don't expect any major surprises in that R&D, but we have to do it.

SSC COST ESTIMATES

Mr. CHAPMAN. You recently announced selection of the industrial team of Parsons, et al., are they going to have time to incorporate their expertise, judgment, and engineers into the April cost updates. Will we get more firm figures later in the year?

How quickly can that team be brought on board, from the standpoint of giving this committee and the Congress some assurance as to firm cost assurances?

Dr. DECKER. The cost estimates that we will have between now and the summer are going to be based on conceptual design. The architect, engineer, construction manager will be doing a detailed design, but they will not begin work on that detailed design until some time in the summer.

We do not anticipate having a contract signed with that group until—I can't remember the date, I think it is like June or July.

Mr. CHAPMAN. How reliable will the new cost estimates be until we have detailed design for the project, by the people who actually will design the project and lay out the work schedules, the management? How positive can we be when we go to the Floor of the House that we will have firm cost estimates?

Secretary WATKINS. I think we will know pretty well, Mr. Chapman, from these two cost analysis groups. That is what they are supposed to be doing, taking a look at all of these things, including the magnet construction contract, so that we can really understand from not only national but international experience of what we might expect in the way of cost for this.

I think that we can be reasonably close. It never will be that accurate. There always has been room for some question that is raised in the R&D program, but I think that by this summer, we will be able to look at all of those excursions and give you some frame of reference around which the cost estimates are made.

So, you can say that looks reasonable with what is going on in the world. How have they been manufactured? What are the problems associated with them? What can we put down as a reasonable center-line cost for that?

I think by this summer, we will have that. I don't think we will have it by April, but we should be close by this summer. I can't give you any better feel than that right now. We are really at the very early stages of doing a good, solid cost-benefit analysis and cost analysis of this entire program, now that we have the new parameters fixed.

SSC FOREIGN PARTICIPATION PLAN

Mr. CHAPMAN. I know this has been a center of discussion this morning, but it is a major issue before this committee. Support for the SSC project is of considerable concern to me. In anticipation of problems, objections and opposition that we know will arise in the process this year, when are we going to know how the Department of Energy is going in the second round of renegotiations with our foreign partners. What are we going to be able to tell our colleagues at the time we are marking up this bill, and we take it to the Floor? What is going to be the response to the question does the Department of Energy have a workable foreign participation plan and can they fill in the blank with dollars and cost of the project? What is our response going to be?

Secretary WATKINS. I did address that earlier in some depth, but basically a summary goes something like this: The international plan has been approved. We have gone through the interagency

process. It is a very detailed plan. It had a lot of potential controversy inside of it.

How are you going to protect technology? What was the flow of technology? What would be the ground rules on which you would make these kinds of early preliminary assessments, and so forth? So, we have that in hand.

Now that we have the parameters in hand, we have already contacted the Government of Japan. Our first team will go over there in June, and this will be the second round. The first round was unofficial. Now, we will get much more serious about it.

By that time, we will have the cost figures pretty well nailed down, plus we will have a lot of the other technical questions answered that they have asked us in the prime rounds. So, I think we can begin to get serious.

I think until we finally decide, with our final cost estimates coming over to the Hill, and within the Administration itself, do we still have a program? In other words, I don't know what the costs will come out to. I think at least $1 to $2 billion more.

Until we can pin that down and be more accurate, I think everyone is a little queasy about real hard, firm commitment, including the foreign nations. They will wonder how serious we consider it. So, we are in that kind of an interim process.

This summer, we plan to get that moving in a more aggressive posture than we were last year, with all of this question about whether or not we had the right physics package.

Mr. CHAPMAN. Let me hasten to add, that where I am coming from there is strong support for the project. I think one of the greatest disservices that we could possibly do would be to be premature in making the assessments in cost and what that final foreign participation should be.

As one who is constantly asked to defend both the management of the project, and Congressional support for the project, I feel strongly that you take the time so that we know as much as we can know what the costs are, and what the right foreign participation balance would be.

If it is going to take beyond the time of this committee's action this spring, we will have to deal with that. But the worst thing, in my judgment, that can happen to us, is to make these decisions and then have to come back and say we are wrong.

Secretary WATKINS. I couldn't agree more. I am pleading you to allow me to do that, and hopefully, by this summer, we can make a decision that we have got a solid program for Fiscal Year 1991, and we want to proceed with it. Then let us continue the work as we finalize both foreign participation and get our program fully together.

By program, I mean the program management that I mentioned earlier. Get the program manager for URA on station and down there and in full charge of cost schedule and performance of contractors. Get our office man down there. We believe we have selected a highly qualified project officer in the field. Get the manager in the Office of Energy Research under Dr. Decker to put full time on this thing and start really staying with cost schedule and performance, which will be a prime focus up here in this committee.

So that all can be done by the summer. By that time, the cost papers will be finished. We hope by June to be able to say, here is where we stand, here is our outlook. Let's go for the Fiscal Year 1991 program, or we have priced ourselves out of business and we have to do other things.

I don't know how it will come out. I think it will be the former, not the latter. Because we will try to make it work. I think it is that important for the Nation.

Mr. CHAPMAN. Thank you.

Mr. Chairman, I know I have used my 10 minutes, and then some. I appreciate the committee's indulgence at this time. Thank you.

Mr. BEVILL. I am going to yield to Mrs. Boggs at this point.

WOMEN AND MINORITIES AT DOE

Mrs. BOGGS. Thank you, Mr. Chairman.

It was really a joy to hear you talk about education, particularly of minorities and women, and the fact that we must start with the youngest children. I enjoyed your recognition of the importance of consortium among universities, schools, businesses, and your Department and other sections of the government. In testifying before another subcommittee the other day, the President's Science Advisor, very strongly spoke in favor of the same type of education thrust.

Of course, the National Science Foundation is now starting with the youngest children and devising curricula and so on. In view of all of that, Admiral, would you please bring us up to date on the Department's efforts to hire and promote qualified women and minorities in management and technical positions?

What kind of representation do women and minorities have in the Department's Senior Executive Service positions, and the mid-level positions? How are you using any new initiatives requested in this budget to affect the program, to upgrade the participation of women and minorities in the Department?

Secretary WATKINS. We have, I think, a pretty good track record. It runs something like this: During fiscal year 1989, the employment of minorities in permanent positions increased by about a few tenths of a percent, from 17.8 to 18 percent, but at least it is on the way up to 2683 permanent positions, but in grade nine and above, the employment of minorities increases by about 140 over the 1309 we had, to 1449, which is an increase of about a full percentage point in DOE grades G.S. 9 and above.

Now, in the Senior Executive Service and G.S. grades to 18, minority employment increased from 25 to 26 individuals, which doesn't sound like much, but it still is important that we are on the trend up. I think the most important thing, though, was in promotions. Minorities earned 570 promotions. For accessions at GS-9 and above, 142 were minorities, or 20 percent. That is better than the representational figures, so that is good.

In 9 and above, the number was 303, or 20 percent, which is 6 percent more than the representational average. So, there again, I think the minorities are doing, and women are doing extremely well in the Department. We hope that trend continues up, and we

are doing everything we can in this whole education field to force it up. We want it to go up. We think this is a critical area for—particularly for those who now feel it necessary to drop out of the school program.

We believe that we can motivate them in technical areas, at the technician level, and they will stay in the business. We can guarantee jobs for them. So I think you are going to see this continue to rise in the Department.

NUCLEAR ENERGY RESEARCH AND DEVELOPMENT

Mrs. BOGGS. That is very encouraging news. If anyone can do it, you can, Admiral.

Returning to nuclear R&D. The Department is pursuing R&D programs in three areas of advanced reactor designs. What factors should we consider in determining the appropriate mix of reactor research for the high-temperature gas-cooled reactor, advanced liquid metal reactor, and the light water reactor?

Secretary WATKINS. I think we have about the right mix for all of these, Mrs. Boggs, in our budget. We will probably be able to spell that out in greater detail as we build the national energy strategy, but it goes something like this:

In the light water reactor area, this is where we have the greatest potential for industry's willingness to work with us now and begin to look forward to a turn of the century new reactor concept; a passively safe advanced light water system. We have two contracts out, one with G.E. on a boiling water reactor, and one with Westinghouse for a pressurized water reactor. Both reactors are about the 600-megawatt level.

We have one 1300-megawatt reactor at one of the contractors who have responded to our proposal. So, this will lead us to single step licensing, pre-licensed by NRC. It will be more safe, that is, all power could be lost and emergency cooling is handled by natural means without any additional equipment having to run.

We have a totally new concept in life cycle managing of that fuel by the integral fast reactor. The integral fast reactor at Argonne National Laboratory is planned to demonstrate in context with this light water system, actinide burnup by the turn of the century. I hope we will be able to look at the integral fast reactor as a reactor to burn up the actinides; that is, those nuclides that are above uranium on the isotopic scale. Then we have taken out the long-term bad actors.

We are then down to a waste management regime that does not require a repository. It could be above the ground, so that we have the hope then, along with the transition to fusion, that we can go to the second generation of fission reactors which are passively safe and in which we minimize the waste generation with the integral fast reactor concept.

So, all of that is in our budget, and is a package deal for the second-generation turn-of-the-century reactors. Now, we want to take advantage of the modular gas-cooled reactor. That is even a potentially safer model. It also has a defense counterpart module for tritium generation in a new production reactor. That makes it attractive, because some of the R&D that is used there, in fact 60

percent of that reactor, is common to a potential commercial reactor.

I believe that we are not viewing that as near-term as the advanced light water system. So, modular gas-cooled is very important, and I would see that as the second generation of the next century's reactors, perhaps coming around 2005, and becoming competitive, assuming that the research that we are doing now goes well.

Then I think the liquid metal reactor will be attractive in the context I just outlined for you for actinide burning. So, I would envision a mix of single licensed, single step procured light water reactors, the possibility of a modular high-temperature gas-cooled reactor, but with an LMR used in conjunction with the water reactors, where we do waste processing on the site.

We put it in the fuel body and burn it up in our systems so we don't have to put the bad actors back in the ground. My successor should not have a Yucca Mountain issue.

REACTOR DESIGN STANDARDIZATION

Mrs. BOGGS. This committee has been very supportive of the standardization of a reactor design. It seems that you are pushing and supporting the work that will have to be done on any certified design before it will be ready for commercial sale.

Since there seems to be industrial support for a vigorous effort of first-of-its-kind engineering, shouldn't we be directing more funding support for this kind of engineering work?

Secretary WATKINS. I think that you have been good to us up here in Congress in letting us do this research. I think if we can get the budget that is in there this time, we are in good shape. We are doing it properly. We are doing it aggressively. We have industry and business support, which is very important, and so I think as far as I can tell, we have a good program, and we are well on track.

I don't believe—obviously, we can handle more, but I am not sure that this is where I would put additional dollars if there are dollars available.

FUSION ADVISORY PANEL

Mrs. BOGGS. Has the Fusion Advisory Panel been appointed, and if it recommends changes in the fusion research program, how do you expect to make reallocation of the 1990 funds? Can you give us a time estimate?

Secretary WATKINS. Yes, the Fusion Advisory Panel has been announced. I sent a letter to the chairman today, giving you the names of the panel and the charter. Mr. Roe has been quite critical of any predisposition to a runoff between ICF and the magnetic fusion concept.

I agree with that. That is not what we wanted. We want them to look at the total fusion outlook for the future to bring all of these various potentially competing technologies into focus in some kind of a longer-range plan so we can all talk about it without having to go into the dark of night with our dark capes on, sweeping into my office telling me the other guy is wrong and I am right.

I hear too many people saying that. We need to know what is really the science and what is its potential for use, and let's see if we can't do a better job of looking mid-range, long-range in the future, and get excitement in the program. We have been poking around with it for nearly 40 years now.

I believe it is getting to the point on the Hill, with other committees who come to me and say I don't see why you don't kill the program, you are not getting anywhere with it. So, I have to face both sides. I think this new advisory panel is talented, with about six neutrals on it, six ICF proponents and six magnetic proponents, all who have been cleared by the committee up here.

I hope they will give us, under the charter we described, a very objective, good, solid look at this. I would like to encourage Congress to support an aggressive support of fusion. I think we should set our sights on that as a long-range nuclear objective.

SPR OIL LEASING

Mrs. BOGGS. Admiral, can you please tell us how the leasing program that the Administration is recommending for the strategic petroleum reserve will work? How would it affect the cost of this program if it were to be adopted?

Secretary WATKINS. I will ask Ms. Smedley, my Controller, she is the expert in the business area on this one, but it goes something like this: We would lease this at $1 billion cost at the end of fiscal year 1991 to whomever leased it from us. That would go into correcting the deficit problems. At the meantime, we would commit ourselves to a defense initiative for 10 million barrels to earmark for defense.

So, we would maintain our national defense security and we would reap additional revenue over the next two succeeding years at $2 billion each. We feel this preserves all of the concerns that Congress had in our prior submissions, and I will have to ask Ms. Smedley to go into details of how that would be executed with a leaser.

Ms. SMEDLEY. I am sorry, Mrs. Boggs, I thought maybe you were asking about leasing of oil in the Strategic Petroleum Reserve.

Secretary WATKINS. Oh, I am sorry.

Mrs. BOGGS. I was very interested in your reply, Admiral.

Secretary WATKINS. Well, we have, as you know, submitted to Congress on the 2nd of February, a very thorough, I think, review of what imaginative options Congress might consider for the future fill of the Strategic Petroleum Reserve. We were directed by Congress to do that. It was a very good drill. The leasing option was the only one that seemed to make sense to us.

We also talked about the volume. But I would like, again, for Mrs. Smedley to talk about that particular problem. I think it does have merit. What we asked you in a letter up here is to see if it has real merit as we talk to the OPEC nations, Venezuela or other nations who have indicated an interest in providing that leased oil, or from our own commercial industry.

I think that there is interest there. I think it is possible, and we want the authority from Congress to allow us to do that; not to commit to it, but to see what is possible out there and come back

and let Congress know, and see if this isn't an imaginative way to get us up to 750 million barrels in a hurry at minimum pain to us. It might be a $7 to $10 million investment that we might be able to cut down by a significant amount.

Mrs. Smedley?

Ms. SMEDLEY. Yes, sir.

Obviously, the economics depend on the particular lease that we might be able to negotiate with a supplier, and the study that we did looked at a break-even case and estimated that we would have the potential of being able to lease a barrel of oil for between 60 and 70 cents per year per barrel of oil, for a ten-year lease under mid-case pricing assumptions.

Based on that assumption, if we were to compare the lease concept to the direct purchase concept for the additional oil needed for a billion barrel reserve, we saw budget savings on the order of $15 billion; $7 billion from the DOE budget and $8 billion for Treasury interest. So, it could cost us less than outright purchase of oil over a relatively 10 to 15-year time frame, depending—whether there is a sale during the term.

A lot of things would have to be worked out and negotiated. But that was their break-even estimate.

Mrs. BOGGS. Thank you very much, Ms. Smedley. Thank you, Admiral.

Thank you, Mr. Chairman.

Mr. BEVILL. The Chair recognizes Mr. Myers.

SCIENTIFIC ILLITERACY

Mr. MYERS. Thank you, Mr. Chairman.

I was interested in your comments a moment ago in response to Mr. Pursell's question if you had a magic wand, what would you do for the country? I guess it would be applicable to any of our problems in the country today. I think you say that you believed that we—this Nation is scientifically illiterate?

Secretary WATKINS. Yes. There are six major scientific disciplines that we have measured our performance vis-a-vis foreigners, and we are not in the top 10 of any industrialized nations. We are hyping on people the extremes on certain issues where the American public can't make their own decisions as well as they ought to be. They will admit this. We all know we are in this situation.

So, it is very important at a time when we have exploding technologies around us and almost $150 billion a year in Federal and non-Federal R&D to make their own assessments. If we are going to spend $19 to $22 million on acid rain, we should have a feeling among the American people of what that means and what it means in carcinogens, or is that the real issue, or is it lakes and ponds or forests? We are told it is possibly not the forests, it is probably from the pollutants coming out of automobiles rather than acid rain.

It is polluting some of the streams, but it is probably not killing as many Americans as smoking. We have 350,000 deaths from smoking alone. So, if you are going to put that many dollars in it for avoiding the deaths of 760, might we not avoid the deaths of far more than 760 with those billions of dollars?

We need to have people who can begin participating in those kinds of technical assessments. Everything seems to be technical today.

Mr. MYERS. I may agree with you, but I wonder if we are just not the wrong people. As an example, you said education is the answer, and education is the answer to many problems, but when I look at some of the people who speak for the scientific community, or at least are reported to be speaking for the scientific community, the Union of Concerned Scientists, we have probably educated the wrong people if they are scientists.

Secretary WATKINS. They are very prominent names in the field. You are right. But I would hope that we would have a debate against them on the other side, and have common sense among those listening in this area of science which is not simple and in which many of them have, for a variety of reasons, eagerly avoided or not been given the tools to get next to it, have got to get into the act and help us weed through it.

It is usually risk assessments. Whether it is the ozone layer is the end of the world or isn't quite the end of the world yet, or whether global climate change is really here, and we are all going to be in serious trouble with Atlantic City being lost in the next years under three feet of water because of polar melting.

All of that is in debate and discussion now. But as we learn more science, we are finding out that the degree of unknowns are far greater than the degree of knowns. We have to have a society that is willing to have some patience beyond even the biannual election year business, to think about where this all fits and where our risks are in life.

Whether I am walking out the door and going to the streets of Long Island, is that more potentially dangerous to me? We talk about risk factors, and we need to deal with 10 to the minus 6ths grams per mile. This is all that we are deliberating.

Mr. MYERS. The thing that worries me is, should we let the Ralph Naders of the country do all the talking. Ralph Nader and people like that are the reason we are second-rate. We are not keeping up from an industrial standpoint. We are not following through on what we do know already. We are not using the expertise that we have now.

We are letting those people do all the talking and the people listen to those people. The people that really know and are concerned about the future of our children and grandchildren aren't being the ones that we are listening to.

Last night, I watched a 60 Minutes program concerned about cutting trees. People are out putting nails in trees and putting sugar in the tanks of bulldozers. These are terrorist activities, and they are being praised. Well, look at the mound of paper we have around here. Those all came from trees.

NATIONAL DEFENSE REQUIREMENTS

So, we do need the use of trees, but those people get all the publicity.

For years, we have been talking about the nuclear weapons Stockpile Memorandum. It seemed to change all the time. This

year, I notice in your comments that you say we are going to meet that Stockpile Memorandum. But last year, you said we had to have the Savannah River reactors operating.

You made some progress, but they are still not in production. When are they going to be in production? Is it necessary to operate them?

Secretary WATKINS. We have informed the Armed Services Committee that we are not going to meet the stockpile. It has nothing to do with Savannah River. It has to do with Rocky Flats. The shutdown at Rocky Flats, I have kept it shut down until we are satisfied that when we start up again, we are not just close to the line, we are well above the line of minimum acceptability in safety, environment and health.

So, we are working with the Department of Defense and with the White House. We have negotiated a slight adjustment down in what we can achieve in the Stockpile Memorandum this year, because of the Rocky Flats situation.

Now, you are right, the Stockpile Memorandum has been squeezed down. President Reagan was the first one to order that in the fall of 1988, and we got on because of the Savannah River situation, and we got on with a whole new program of taking a look at tritium as the long pole of the tent, and the driving factor.

How do we optimize tritium and keep the stockpile viable? Three changes took place last year to keep weening ourselves away from a less—let me say, a less disciplined approach to weapon management in the field. Just to focus on how to optimize the tritium availability. I think this should have been done before, perhaps, but we have been able to stay ahead of the tritium being the long pole in the tent as long as we start the reactors up within this year.

REACTOR RESTART

Mr. MYERS. When will they start?

Secretary WATKINS. I have said publicly that the reactors will come on line, we think, the K reactor, in the third quarter of this calendar year, and we will go to power——

Mr. MYERS. That is pretty soon.

Secretary WATKINS. And we will go to power, that nominally 50-percent power for the first two years probably by the end of this year, in the fourth quarter of the calendar year. Now, we will be able to clarify this probably in April and come out with a definitive startup date. But we can't do that yet, because we have—still have some unknowns.

I don't want to put out any dates now that don't really ring true with our environmental impact study, with all of the reactor testing that is going on and so forth.

Mr. MYERS. Why didn't we start it simultaneously with the renovation of the reactors?

Secretary WATKINS. When I took over the Department, I knew we were in such serious trouble down there that I had to find out what the new baseline of knowledge was, my knowledge of what is really going on at Savannah River before I agreed to anything. I

said I won't agree to anything now until I understand what is going on in the reactors.

It came clear as we put up the startup plan last summer that we should be doing an EIS. But I didn't know that until I saw the data. That data had nothing to do with what I saw on March 1, 1989.

Mr. MYERS. You can see how we feel.

Secretary WATKINS. Yes, sir. We have had the first visit by the Congressionally-mandated Safety Oversight Board, Mr. Conway. They found that unless we got on with a much more aggressive training program, that even what we now had with Westinghouse down there, we wouldn't make the startup dates this year, and they were right.

So, the Congress has said, when you don't agree with them, you have to tell us within 90 days. So I tell you, I agree with them. There isn't any contest between Mr. Conway's group and my group. This is like a mini-NRC. They are tough and good and they know what they are talking about. They are helpful in the sense that they give further ammunition to me to make sure that the Westinghouse people down there and our people understand the seriousness of the cultural change in the operation.

Of course, they are good people. It is not their fault. We never gave them the quality education program to operate the plant safely.

Mr. MYERS. When we have the new reactor, will Savannah River be able to supply enough tritium?

Secretary WATKINS. Yes, sir. They have three reactors down there. They will have the capacity not only to do that, but generate the Plutonium 238 for the space program. If they can do the tritium, which they must do for nuclear deterrence, they can do the Plutonium 238 on the side. They can basically go around the rim of the reactor and don't degrade the performance of the reactor.

FAST FLUX TEST FACILITY

Mr. MYERS. Is that the reason we are going to phase out the Fast Flux Test Facility?

Secretary WATKINS. Yes, sir, that is the primary reason. We looked—you don't like to shut down the newest, best run reactor you have, but it came on line for other purposes, to support research for the Clinch River reactor. When that rug was pulled out, we tried to find a mission for it.

While we are doing a few things for the Japanese and a few good research projects, they don't warrant the $100 to $115 million a year it costs to run. We can't justify it. I would be wrong to come up here and not ask you to take the actions we have asked. It was a tough decision. It was not something that I anticipated last fall.

I thought maybe we could keep it on line for the Plutonium 238, but FFTF cannot produce Pu-238 soon enough to meet the Cassini and CRAF missions for NASA, and for going to Saturn, but Savannah River can.

6–7 GEV SYNCHROTRON

Mr. MYERS. It seems now the industrial community has supported the importance of the 6–7 GeV Synchrotron. Is that on schedule?

Dr. DECKER. Yes.

Mr. MYERS. Is that an increase in cost?

Dr. DECKER. We don't have any cost increases there.

Mr. MYERS. Okay.

The longer you stretch them out, the more they cost. Could more money facilitate completion?

Secretary WATKINS. You have a good point. I looked at all our programs, and if you were unconstrained in defense, you would upfront your money to minimize the total estimated cost of the program. This is what industry does all the time. If you are going to make a decision, make a decision to go with it, but don't stretch it out so far.

What happens is on many programs, we tend to say, well, we can stretch a little bit and won't lose too much this year. In a lot of these research programs, you would like to do more. There are selected ones, very high priority, the advanced photon study at Argonne, for example, where you could come in at the TEC projected if you could ramp up at a higher number of dollars and get yourself postured to be the international leader in superconductivity material analysis, which it does.

It looks at the atomic structure of materials, copper, whatever it is out there, oxide; and does the analysis atom by atom. How do they line up, when do they line up, under what conditions and so forth, which is very important.

So, if you can get that on line, you may win the race of superconducting material, for example. You don't know that. So, the answer is, it is a long-winded answer, but you have an important point that there are selectly highly important programs that somehow, if the tooth fairy arrives, I would want to work with you to accelerate.

So, those procurements, because I think they get into the area of international competition as well. I think we are missing out by saving $45 million this year with a modest stretch-out of the advanced photon source, we are probably making a mistake not doing the research that is essential to understanding the atomic line-up.

FUSION ADVISORY PANEL

Mr. MYERS. I feel like we in Congress are like a juggler. We have so many balls in the air. Maybe we should have fewer projects and adequate funds to finish the ones we have instead of stretching all of them out for so many years.

Along the same line, talking about fusion. I see you have appointed the Fusion Industry Policy Board. What kind of power are they going to have?

Secretary WATKINS. They will have a lot of power. Seven plus six plus six, so it is 19 individuals, highly qualified, nice balance.

Mr. MYERS. Never get a consensus.

Secretary WATKINS. I think we will get a good report, which we will be giving to you all up here.

Mr. MYERS. When? When will we hear from them?

Dr. DECKER. We are looking for a report from them probably in July, and a final report by the end of September. The panel is scheduled to go out of existence at the end of September.

Mr. MYERS. They will meet full-time then?

Secretary WATKINS. I don't know if it will be full-time, but we will have a full-time staff to support them to do all of the things that they direct us to do. It will be a pretty full-time job, certainly, for the chairman and for many of the people on there to coordinate this.

Mr. MYERS. This is another area where we felt like we have been a juggler. We have had so many fusion programs and none of them are really producing anything. It is really frustrating for us.

When we first got on the committee, we started building Princeton, and then we went out to California and started and aborted that one. It seems like we can't ever settle down and go in one direction.

Secretary WATKINS. This is why I thought it was important last year to let the Congress know we were not going to ignite at the Tokamak Upgrade in Princeton. We have a solid program here, over $87 million again for the plasma physics laboratory up there at Princeton. I think that is important.

But we need to regroup with technological explosions taking place, and where scientists feel constrained to come in and tell me that we can do it better. By the same token, they cannot prove that ICF is the way with pulse lasering, that you don't put more into the laser than you get out of the machine. I think about every five years for one of these long-range programs like this, you need to bring in the best pros in the world and take a relook at it.

I think that is what we felt we had to do now. My briefings from the advisory committee that Dr. Bob Hunter had was that there was still considerable confusion, but almost total agreement that they would not ignite with the monies proposed for the ignition device at Princeton. That doesn't mean you won't get good research out of it.

It doesn't mean that that would be the only way to go. But I want someone else to tell me that is not connected with the constituency up there. I have to satisfy other chairmen over there that we are taking another alternative look, and we really are convinced that we have something going here.

There are tremendous physics unknowns in why we can't catch the rabbit and why we get closer to ignition and the rabbit runs faster. So, it is a very complex set of issues, and the physics, qualities in the plasma at that point are unknown.

I want to go after the unknowns before we make additional investment in hardware. I want this panel to help us out. They may say you have no choice. If you want to get on with this, get on with it. At least I can tell you there is a rationale for spending $400 million more on an upgrade of that system.

Mr. MYERS. Mr. Secretary, I have a number of other questions I will supply for the record, and I appreciate your response. In ending, I do congratulate you for the very difficult job you are doing.

The Department of Energy leads us down a path, and we follow, and all of a sudden you say, we don't want to do that, we changed our mind. We want to do something different. That has happened frequently to us that we are somewhat gun-shy.

So, your analogy of using a rabbit is appropriate here. We have too often chased the wrong rabbit. So, thank you for the job you are doing. None of us are scientists, so we aren't for sure that we know what a rabbit is scientifically.

Secretary WATKINS. You will know when it comes after you.

Mr. MYERS. After the fact, we have learned. Thank you.

HEATING OIL SHORTAGE

Mr. BEVILL. Mr. Secretary, last December, we had the sub-zero winter, and we had a shortage of diesel fuel and the old law of supply-and-demand went into effect. Prices skyrocketed and we had utility bills skyrocketing. You immediately stepped in and began a review to see what legislation was needed, if any, to prevent that from happening again.

Could you give me a brief summary of what you found and what you recommend be done in order to prevent that situation again?

Secretary WATKINS. Yes, sir, Mr. Chairman. We injected ourselves into that process, and we learned a lot about it; a lot of lessons learned for the Department of Energy. Many years ago, we lost any authority to adjust cost or sales of energy under those circumstances.

I think it was 1981, it was disallowed for the Department of Energy to inject themselves in price controls or anything of that nature. But we did bring a large number of people from the industry in to discuss the situation up here, and what we needed to do.

The first thing we did was try to move quickly to get some Jones Act waivers, so that ships carrying the propane for offshore sales could be diverted. The process was very sluggish. We finally got permission for two Jones Act waivers, and those ships were actually turned around and sent back to the New England area for offloading of their material.

So, we were able to make some strikes, but frankly, we could have done it faster. We just didn't have, until Secretary John Easton got on board, the visceral feel that we had to get into the act. Then we found out we didn't know where the propane is in the country. We don't know what the storage capacity is anywhere in the country.

We don't have a good handle on heating oil. We know generally what the global and national picture is on heating oil, but not the specifics. Where is it located? What are the transportation problems? So, we are in the middle of that process now, coming out from under that period going through all of these lessons, and learned to jack up our response team to be much more involved.

We are not ready to ask you for help yet, but when that is complete, which I believe will be complete about the time we get the analysis of any excess profits that might have been made after we look at the end of the March report, so I am thinking that in the April-May time frame, we will have that report and tell Congress

what we have done to jack up our emergency response team to be more cognizant of heating oil and propane.

It apparently has not been the Department's bag. It caught us a little short. We came in on the 23rd of December, I think, with industry and business. It was beneficial to have that session. It was hard-hitting on how to minimize the damage and get the heating energy sources up to New England.

So, we will be better equipped next time this comes around.

Mr. BEVILL. You do this administratively?

Secretary WATKINS. Yes, sir.

Mr. BEVILL. All right.

The Chair will recognize Mr. Pursell.

Mr. PURSELL. Thank you, Mr. Chairman.

From the discussion today, and maybe Mrs. Boggs would agree with me, maybe the Secretary should be the Education Secretary. We would be moving a little bit more aggressively. I also sat on that subcommittee, and I feel you might be in the wrong position.

DOE CONTRACTS

I want to take up a couple of minutes on contracts. Roughly, how many contracts does the DOE have?

Secretary WATKINS. I think 50,000, including small purchases. About 1,500 to 2,000 are over $25,000 and we are required to administer them. Our major contracts have subcontracts underneath them, probably 150,000. So the total is about 200,000 contracts of all types.

Mr. PURSELL. Could you tell me how many were sole source?

Secretary WATKINS. I can provide that for the record, Mr. Pursell.

[The information follows:]

DOE CONTRACT AWARD INFORMATION

As of September 30, 1989, the DOE Procurement and Assistance Data System identified a total of 1,935 active DOE awarded contracts, including those of the Federal Energy Regulatory Commission, the Bonneville Power Administration, and the 51 Management and Operating contracts for operating DOE's Government-owned Contractor Operated facilities. The data base shows a total of 619 noncompetitive awards, of which 229 were minority set-aside awards under the authority of section 8(a) of the Small Business Act. Another 14 were directed by statute to be made through another agency or from a specified source. Additionally, a total of 85 of the noncompetitive awards represents a unique source, or the only source available for the required work; and over 100 represent awards to continue follow-on work, awards based on unsolicited proposals, and awards to utility companies.

CONTRACTING POLICY

Secretary WATKINS. There has been a policy in the Department for many years just to extend and extend and extend. I think that is the reason we got into trouble at Savannah River. We have changed our practices. We just put out a Notice of Proposed Rule-Making with some of the Majors on indemnification, which is going to be a totally different ball game on how we run our contracts.

There will also be competitive bidding, and we will not allow the continuing exception except when we have documented top performance. We are willing to make an extension for a period of time, but then to commit to rebidding at some point, maybe the

next go-around, rather than go on year after year after year with extensions.

Mr. PURSELL. That is an overall policy, contracts should be competitively bid?

Secretary WATKINS. Some are very difficult, and will have to be analyzed on a case by case basis. We have two very fine contractors that are essentially there solely for the Naval reactors program, Westinghouse and General Electric in Schenectady, New York. I don't think we should change those.

Basically, they have built over 35 years of expertise. Nobody else in the country can do that kind of work. It doesn't exist. I think that Naval Reactors is a different story. We also have not for profit universities and academic consortia running our laboratories which are also a different story. They are audited and monitored to see that they are fairly handled and paid basically for their operating costs.

So, there are different kinds of contracts we have. For the for-profits, however, if you read the proposed rule-making, it is tough and good. There is a certain amount of shift in liability for certain negligence actions that we think is not appropriate for the Federal Government to keep picking up year after year after year, where they violate their own procedures, for example, or carry out some negligent action that we should not pay for, such as the water hammer at Savannah River.

So, we have a significant change taking place now. I will provide the old data, but I would also like to provide you the new policy, which we will be applying to major contracts, within about a month.

Mr. PURSELL. Take a contract in the fusion ICF program, it goes to the University of California, Sandia, Los Alamos, Livermore, Rochester, KMS and the like. A couple of them are private and one is a university. Maybe we should be looking at those programs and see if they should be put into a competitive mode. Maybe we should not follow the bureaucracy where we put everything in the private sector out for competitive bidding. We should continue with a lead laboratory concept, which has led to some progress in the fusion area.

I think some of our labs are deficient in that area.

Secretary WATKINS. I will ask Dr. Decker to talk in a little more detail, but I would say that we have to watch out for the laboratories, where we have probably two-thirds of the scientific intellectuals in the Nation. We have to be cautious and we should maintain that capability in the Nation, and it certainly isn't all in defense or in basic science.

It is across the board. That is probably our most unique resource nationally. We have to watch carefully that we maintain that. ICF is born out of the defense programs.

TECHNOLOGY TRANSFER

Mr. PURSELL. I know that much of it is classified, but some of it should be declassified and some should be subject to competitive bidding.

Secretary WATKINS. What you have just identified is probably the most important issue that we have going, the technology transfer. The technology transfers we have done with every SDI technology at Lawrence Livermore, have already been transferred to the private sector. We have to be able to separate the classified from the non-classified, and the latter is far greater than the former.

What we haven't done well in the past is take technology spinoff from the defense laboratories and move that across the line into the white program area, so that everybody can take advantage of it, such as ceramic engines. So, you will see technology transfer is a line item and you will see us working more aggressively, and it is to do the very thing you are talking about, to take things out of the classified areas, and move it into the commercial sector.

We are already doing that. The SDI is a classic example. We were just briefed out there with the President that every single one of the pieces of technology in Brilliant Pebbles has moved into the private sector. I am talking about Cray Computers the size of a 50-cent piece. Lasering techniques from small machines that can identify a million objects and classify them. All of them have a commercial spinoff not in those areas, but in a lot of areas to do medical diagnostics, and a whole range of things that are very important.

So, we are going to be in the middle of that. That is where the competitive bidding comes in. But I think in all fairness to the laboratories, it is very important that we be cautious lest the laboratories no longer maintain this not-for-profit stand and doing a public service. Most of the scientists I am familiar with are right in there working long, hard hours for the good of mankind, and they are not in there for self-gratification or self-profit.

They are the ones that are going to pull us up by our bootstraps and give us a competitive boost. We have to help them take their brilliant ideas and commercialize them. That is a different skill. We haven't given the skills to our laboratories to do it, setting up new processes to expedite it.

Mr. PURSELL. Sandia and Los Alamos should be subject to total review with regard to fusion?

Secretary WATKINS. Well, the elements of the fusion program that they own will be under review by the new Fusion Advisory Panel, yes, they will. They will not buy off on anything. They are going to start from scratch and look at what we have and see whether we should restructure our program.

Mr. PURSELL. Thank you, Mr. Chairman.

Mr. BEVILL. The Chair recognizes Mr. Chapman.

Mr. CHAPMAN. Thank you, Mr. Chairman.

SUPERCONDUCTING SUPER COLLIDER

Mr. Secretary, let me ask just a couple of questions about the SSC, and then I have a couple of things I would like to ask in the area of national energy policy. It is obvious you considered and apparently did not go along with any thought of reducing the power of the SSC.

I would like to ask you, is it your position that the Administration firmly supports that the SSC should be built to the full power, the 20 TeV as opposed to any reduced power level?

Secretary WATKINS. I can say that it is Dr. Bromley's and my position that the data that we reviewed from the High-Energy Physics Advisory Panel justifies the 20 TeV, nothing less, justifies the 2 TeV injector as being the proper energy to match that 20, and justifies the five centimeter aperture, and we agree with that.

The issue will be on realistic budgeting, and are we going to really put this kind of investment in when we have the hard figures in hand.

Mr. CHAPMAN. To build that machine?

Secretary WATKINS. Yes, to build that machine and still make this the number one program objective that I have been given by the President and the Office of Management and Budget. This is the only program listed as a major budget objective for the Department of Energy. It is the national energy strategy, waste cleanup and the SSC. Those are my three that I was given by the President.

So, as of this point it is, but I think as someone mentioned here earlier, there is probably a limit to which the Hill and the Administration itself is going to have to fund it unless we are closing a cost and not expanding on a cost.

SUPERCONDUCTING MAGNETS

Mr. CHAPMAN. This is a bit of a follow-up on a question I asked earlier about the magnets. I want to make sure that, if I am right about this, that the record clearly reflects where we may be going. I think there is some confusion about magnet technology.

Is it correct that the R&D efforts currently under way are not to design a superconducting magnet? That is not the issue. The R&D efforts are to fine-tune superconducting magnets to the application of the SSC? We are not trying to figure out how to build a superconducting magnet; am I right or wrong?

Secretary WATKINS. We have built magnets that are, let's say, 53 to 60 feet long. They are out at Fermi. There are a half a dozen of them out there. They have all performed to the specs demanded of them in the supercolliders. They are four centimeters, not five, not that it would make that much difference.

I think they plan to hand-build about 50 of those magnets. But now the question is, can we extrapolate that to a production line magnet and do the job well? What are the technological issues that research has to tell us to make sure that we are going to get the applied technology from the hand-built magnets to something we can get off the production line?

We are not going to build 8,000 of those or 12,000 of those by hand-winding. You can watch the facility out there. It is an impressive facility. They have been able to demonstrate that this magnet performs in all of its right ways.

It can define the beam and be aligned and meets all of the technical specs imposed on it. But the research still has to be in producibility, manufacturability of that. We think we can get there. People are not giving us any sad looks on the thing. They are just saying we have to do it.

Mr. CHAPMAN. There is still some confusion among my colleagues and there is a lot of talk that we do not currently have the ability, and that our R&D efforts are focused at building a superconducting magnet. We don't currently have the technical ability to do that. That is what I wanted to clear up.

Secretary WATKINS. We have designed these magnets and they perform to specs, and that is about down to 4.3 degrees Kelvin. It does the superconductivity and meets all of our specs. We can control the beam, illumination and so forth.

I don't think that is a problem. The problem is, can you build them on a production line, and we think that we can take a lesson from offshore on that one and take a look. I think the answer is, we have to prove it. We have to have demonstration of that, and I think as far as I know that is the long pole in the tent there.

NATIONAL ENERGY STRATEGY

Mr. CHAPMAN. Okay.

On the matter of a national energy strategy, let me ask you, now that we have gone past a 50-percent import level of oil, do you see a national security implication to a continued increasing reliance on foreign oil?

Secretary WATKINS. Being an old military man, I would never say that it wouldn't be a threat to national security, witness what happened to the Persian Gulf and the expense. On the other hand, we do have changes in the world, and I think there is some indication out of OPEC that they are extremely serious about stabilizing in the future, that they are not interested in going back to a situation we had in the seventies.

I think that is very sincere. I am hopeful that we will have a chance now to go through the decade, which will surely show an increase in imports. I do not see them coming down in aggregate. Over time, they will continue to increase.

No matter what we do in the clean air bill, it is a step in the right direction to alternative fuels. No matter what we do in renewables and conservation, this Nation will have a voracious appetite for oil in the future. All our predictions say that imports will go up.

Now, is that a national security problem? Somebody wiser than I will have to say we will not have any kind of a world, global unstable situation that would give rise to the same problems we had before. Nobody is going to want to interfere with our lines of communication. I am not smart enough to say that.

I think we always have to worry about it. Our best goal would be to find out, can we turn that import around? I don't think that can be done until probably 20 years from now. Maybe we can stabilize it with alternatives to oil in this decade and lay the groundwork, but I do believe that that is going to continue for the foreseeable future until we start driving electric automobiles or other things, and then we will have to find powerplants that use other than oil. Much of the peakers right now are oil-fired.

So, we have some concerns. There is a lot of talk about using natural gas, because it is clean and efficient. But natural gas is no panacea. We need to use it for coal combustion and other things,

firing of plants. But we can't rob Peter to pay Paul. We have to watch any finite natural resource. All we are going to do is switch from import of oil to import of natural gas.

We are seeing liquid natural gas coming back into the country even as we speak, and probably by the middle of this decade, it will be coming back in larger amounts. In the Chesapeake Bay, oil companies have begun to make deals now, and will start offloading natural gas even on the Chesapeake.

So we have that kind of a situation. I can't tell you whether it is a threat to the Nation specifically, because I just don't have a good enough picture on world stability to know what is going to happen in the Middle East. That is primarily the big issue.

Also, there is a question about the expansion of the Soviet Union and their natural resources and the transfer of technology. So, much of that will be interfaced in the national energy strategy. We will be hopefully able to look at that. But it will be a long time before we turn over the import curve and get it heading down.

Mr. CHAPMAN. In some of the projections, and you mentioned in your testimony that we could easily be in this decade at 60 percent imports. I heard conservative projections that by 1995, it could be 65 percent or more. We would be importing two out of three barrels of oil.

If, in fact, that is the case, and if, in fact, more and more of that came from the Middle East if we don't explore our offshore resources and perhaps the Arctic Wildlife Reserve, I believe that it is folly not to try to explore additional technologies that would help us perhaps recover more of our own domestic supply.

On the Science and Tech Committee, I heard a lot of witnesses say, we have a three or 400-year supply of natural gas in the lower 48 States if we spend money to develop it, and the same with crude oil. Yet, there seems to be pretty much level funding in that effort.

GEOSCIENCES

Secretary WATKINS. I think you will find in our budget, we shifted a significant number of dollars over to applied research with industry. We shifted away from the policy inherited on oil and gas, which was high-risk research only.

There are times where you want very short-range applied technology, because we only have 40 years left of oil and gas reserves, depending on how you listen to it and calculate. So, you will see a shift in the budget of significant dollars in R&D initiatives to help us out in this area. We put $17 million of additional monies, for instance, in the geoscience initiative.

It gets to the area that you are talking about. It talks about getting closer to the oil and gas industry to see what we can do for enhanced oil recovery; should there be more work done in horizontal drilling? Apply the best technology right now to make sure that we know exactly where we stand on the existing reserves that we have, so that we can address intelligently the ANWR range and any more offshore oil and gas to put in perspective. What if you don't do ANWAR, which has projected about 10 years' supply of oil?

Can you get through this transitional period, or are you going to be importing 70 or 80 percent of our oil?

Mr. CHAPMAN. I applaud the effort, but we are still spending four to $500 million on clean coal R&D, and here we are spending $17 million for a partnership, which I think is exactly the right direction.

I am worried that we should do much more. When you look at the total R&D budget at the Department of Energy, just such a small portion of it is going into oil and gas research. When we listen to the geologists, I am not a scientist, but you listen to these people talk about reserves here in this country, and yet we are spending scant little money on the research program.

It is a question. Is it a national security issue, to turn our reliance on imports around. Should we produce more domestically as long as oil and gas is our basic transportation fuel?

Secretary WATKINS. We would like to get up and talk to you about this. We have never done this before for a number of years. We haven't really focused on near-term research to get right in with business and industry and really put a full court press on the near-term. We are taking dollars away from the long-term and being aggressive in the near-term.

Maybe we should have done that over the years, but I think we have a good start. We worked with the oil and gas people. We have talked to them about this portion of the budget, and I think they have applauded this movement.

Obviously, there might be more to be transferred if there can be some things to take out and put in the near-term. But we think we have a balanced program to carry out near, mid and long-term objectives, to maximize the recovery from the fields we have.

I think we have to do that before the ANWR debate starts again, which will be after sometime when we call feel comfortable and can handle the next Exxon Valdez.

Mr. CHAPMAN. My primary fear is in the development of our national energy plan. It seems that we are placing a lot of emphasis on conservation efficiency and alternative fuels. There is an awful lot of oil and gas right here and that that should to be a key component of the plan

I have not heard discussion from the Department of Energy as this plan is developed. I am not hearing much discussion about that. I am disappointed. I think the direction is perfect from the standpoint of the private—government sector, but I just think $17 million, quite frankly, is a pittance.

Secretary WATKINS. That is just in geoscience. That was just in one initiative to migrate dollars into very important near-term areas. I think our total budget on oil and gas R&D is $54 million.

Mr. CHAPMAN. Still about 1 percent of the DOE—

Secretary WATKINS. We have a tremendous R&D initiative going on in the private sector. We are trying to fill in the blanks where they feel they need help from us. We are connected with them on this horizontal drilling and what we might do to enhance that.

Mr. CHAPMAN. I certainly hope you will continue as you have, and I applaud your efforts in that area. But in the development of this national plan, I see terrible national security implications where we are relying on significant imported oil.

Secretary WATKINS. I agree with you.

Mr. CHAPMAN. Thank you, Mr. Chairman.

Mr. BEVILL. Are there any other questions?

WETLANDS EXPLORATION

Mrs. BOGGS. I would like to follow up on that question, Mr. Chairman.

Louisiana coastal wetlands, Mr. Secretary, of course, offer the promise of additional oil and gas reserves. Is the Department looking into any new and innovative ways to exploit these reserves while protecting the fragile environment?

Secretary WATKINS. I don't know exactly what we are doing there, Mrs. Boggs, in specific terms. I can certainly look into that. I am not equipped today to answer that.

Mrs. BOGGS. I would like an evaluation especially of the technology, such as Hovercraft and so on.

Secretary WATKINS. If I can, I will provide answers and a summary of what we are doing down there for the record, and maybe have suggestions for you as to what we might do in addition.

[The information follows:]

WETLANDS MITIGATION PROGRAMS

The Department of Energy does not currently conduct any activities in wetlands mitigation associated with oil and gas exploration and development. However, this is one area of environmental research described in the forthcoming implementation plans for the oil and gas programs for possible future work. These plans will be available in final form by March 31, 1990.

The Office of Fossil Energy has received one unsolicited proposal to study the feasibility of innovative methods of transporting drilling rigs for gas exploration in the Louisiana wetlands to minimize environmental damage. This proposal is currently under review.

WOMEN AND MINORITIES IN SCIENCE

Mrs. BOGGS. Thank you.

Speaking of statistics, Dr. Kelly, who is President of Tulane University, said a couple of weeks ago, if the trend continues of young American white males going into law and business, that by the year 2000, we will need 95 percent of minorities and women in the sciences and math.

Secretary WATKINS. Our figures show about 85 percent of the new entrants to the work force in the year 2000 will be minorities and women. Therefore, we are going to need them very definitely in these fields that we are talking about, which is in such great supply.

If you read The Washington Post employment wanted, help wanted category, this Sunday, it was as thick as I have ever seen it. All in the areas that we are talking about, where we have unlimited employment opportunities, and yet minimum skills to fill them, even in the most simple area, such as in fast food services, where computers are used to handle the customers. We really are in a serious condition. He is absolutely right.

Our figures show 85 percent as being a required entry. So, if we are not preparing young women and minorities in these fields, the leadership will be adversely affected in years to come.

Mrs. BOGGS. Thank you so much.

Thank you, Mr. Chairman.

Mr. BEVILL. Any other questions?

Mr. CHAPMAN. Mr. Chairman, no questions, but I would like to ask the Chair's permission to submit additional questions for the record.

Mr. BEVILL. Yes. Without objection, it is so ordered. That will apply to all the members who have—including myself—questions that will be answered on the record. Also, Mr. Dicks, who is a member of the House Appropriations Committee, has sent me word that he may have some questions that he would like to submit for you to answer on the record.

Mr. BEVILL. Admiral, if you will, I wish you would place in the record the group of scientists that you have pulled together——

Secretary WATKINS. A letter is coming to you today. You should have it in your room when you return to your office, that gives you the charter and the names of members of the committee, the 19 members.

Mr. BEVILL. You are talking about the fusion group, and that is fine. But the group on the SSC, that advised unanimously on moving forward. If you would put that list in the record.

Secretary WATKINS. I will be pleased to do that.

[The information follows:]

SUPERCONDUCTING SUPER COLLIDER

The High Energy Physics Advisory Panel (HEPAP) was asked to review the physics potential of the SSC in relation to the technical goals for the facility. A subpanel was established, chaired by Professor Sid Drell of Stanford, and contained five Nobel Laureates. Their report, which was unanimously endorsed by HEPAP, strongly recommended retaining the original 20 TeV energy goal. The report of the subpanel follows, together with a list of the HEPAP membership:

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REPORT OF THE 1990 HEPAP

SUBPANEL ON SSC PHYSICS

January 1990

U.S. DEPARTMENT OF ENERGY
OFFICE OF ENERGY RESEARCH
WASHINGTON, D.C.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LABORATORY FOR NUCLEAR SCIENCE
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JAN 12 1990

Dr. James F. Decker
Acting Director
Office of Energy Research
U.S. Department of Energy
Washington, D.C. 20585

Dear Jim,

I am writing to transmit to you the Report of the Subpanel on SSC Physics. This report was endorsed unanimously by the High Energy Physics Advisory Panel (HEPAP) at its meeting in Washington, D.C., on January 12, 1990. The Panel strongly supports the conclusions and recommendations of the Subpanel report.

Timely completion of the Superconducting Super Collider (SSC) remains the highest priority of the national High Energy Physics program. The physics research to be done with the SSC is essential to the improvement of present human understanding of the fundamental forces of nature and the underlying constituents of the physical universe in which we live. The SSC is certain to be a focus of worldwide scientific attention for decades to come.

The Subpanel has concluded on physics research grounds that any substantial reduction in the energy of the SSC would compromise our ability to elucidate the nature of electroweak symmetry breaking, a truly fundamental problem at the core of the Standard Model. This is because, with 20 TeV beams, there is confidence that these phenomena can be studied in whichever form they may take, whereas this confidence is quickly lost at lower energies. In addition, no substantial increase of luminosity can make up for a reduction in energy because no multipurpose detector is capable of operating well above 10^{33} cm^{-2} sec^{-1}, the design luminosity of the SSC. Only limited purpose, specially designed detectors can operate at higher luminosities, and these are not capable of thorough exploration of the phenomena in question.

In conclusion, the Panel endorses the energy and physics research goals of the SSC as currently proposed, and its timely completion by the end of the decade. We urge the Department to take the steps necessary to bring this about.

Yours sincerely,

F Low

Francis E. Low
Chairman
High Energy Physics
Advisory Panel

Enclosure

STANFORD UNIVERSITY

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January 9, 1990

Dr. Francis E. Low
Chairman of HEPAP
Laboratory for Nuclear Science
Massachusetts Institute of
Technology
Cambridge, MA 02139

Dear Francis,

Transmitted herewith is the report of the Subpanel on SSC Physics which met at the SSC Laboratory (SSCL) in Texas on January 6-8, 1990. In preparing our report, we not only heard from Dr. Roy Schwitters, Director of the SSCL, and other SSCL staff, but also from Dr. Carlo Rubbia, Director General of CERN.

As requested, this report focuses on the physics research to be done at the SSC and provides advice on the range of useful machine parameters in order to complete the design phase of the facility.

The Subpanel concludes that the SSC Laboratory, in its current proposal, has chosen wisely among the alternatives and that the project should move forward expeditiously. We feel strongly about the need for a flexible and reliable facility at 20 TeV beam energy for decades to come, and, therefore, we believe it would be very unwise to redesign the machine with a reduced circumference.

Sincerely,

Sidney D. Drell
Chairman, Subpanel on
SSC Physics

Enclosure

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REPORT OF THE HEPAP SUBPANEL ON SSC PHYSICS

In 1983, the high energy physics community set as its highest priority the construction of a proton-proton collider having a beam energy of 20 trillion electron volts (TeV) and a luminosity[1] of 10^{33} cm^{-2} sec^{-1} (see Appendix A). Approved for construction last year, the Superconducting Super Collider (SSC) will be a unique instrument for exploring new research frontiers. No comparable facility is being planned anywhere else in the world. Because of its size and uniqueness, the SSC will be expected to operate for many decades and, therefore, should be built with high reliability and with flexibility to support a broad research program. It is important that it be completed before the end of this decade to ensure continuity and productivity in the U.S. high energy physics program.

The SSC is now undergoing site-specific final design in Texas. We have been constituted as a Subpanel to the High Energy Physics Advisory Panel (HEPAP) and asked to provide "advice on the range of useful machine parameters in order to complete the design phase of the facility" in view of practical financial constraints.[2] This report is our response, and, as requested, "focuses on the physics research to be done at the SSC."

The very spirit of physics is to explore the unknown. This makes it impossible for us to predict precisely what we will discover in the future. Based on our present knowledge, however, we are confident that the SSC will explore a region in which major new discoveries will be made. The SSC specifications were established with this goal in mind, and experience gained since 1983 has strengthened our conviction of the importance of constructing a proton-proton collider with the beam energy of 20 TeV and luminosity of 10^{33} cm^{-2} sec^{-1}, as originally proposed.

The SSC Laboratory (SSCL) management has developed a detailed site-specific design which resulted in an increase in the estimated total project cost. We were told that this increase is substantial (in the neighborhood of 20 to 30 percent above the $5.9 billion derived from the 1986 proposal of the Central Design Group). The cost increase arises primarily from two types of changes. The first type involves recalculation of labor and materials costs and requirements for magnet R&D and instrumentation to assure reliable accelerator performance. The second type involves technical changes (higher injection energy and a larger magnet aperture). Based on recent experimental and theoretical findings, the SSC Laboratory judges these technical changes to be required for reliable operation. We have reviewed these technical changes and the reasons for making them, and we conclude that implementing them will ensure confidence in reliable and timely operation of the SSC.

The Subpanel concluded that the only way to keep the cost of the SSC at $5.9 billion would be to seriously reduce its capabilities. We considered whether there are cuts that would allow substantial savings and that could be made in the initial design but restored later. We found none (see Appendix A). One possibility for substantially lowering the

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[1] Luminosity is a term used to specify the intensity of the beams in a collider. The higher the luminosity, the greater the rate of collisions.

[2] Letter of December 21, 1989, from Dr. James F. Decker, Acting Director of the Office of Energy Research, to Dr. Francis Low, Chairman, HEPAP (see Appendix B). Subpanel membership is listed in Appendix C.

SSC cost would be a major reduction of the collider circumference from 54 miles. This would reduce tunneling costs and, correspondingly, decrease the number of magnets needed and the energy that could be attained. As far as we could judge, a really substantial cost saving that would return the estimate to something like the original $5.9 billion would require a reduction in circumference and beam energy by approximately 25 percent.

We have examined the physics potential that might be lost by lowering the machine energy by such an amount. It is always difficult to be precise in advance about the energy that is *needed* in a new machine. Certainly, no one knows enough to say that 20 TeV would be adequate, but 19 TeV would not. There are various scientific targets for which the reach of the SSC would be proportional to its energy. For instance, physicists have speculated about a variety of new particles, the discovery of which would mark a watershed in our understanding of physics, but for which we have no plausible predictions of mass.

There is, however, one class of phenomena, related to the breakdown of the symmetry between the weak and electromagnetic interactions, for which we can be more definite. The question of electroweak symmetry breaking is of truly fundamental importance. It represents the single greatest uncertainty in our present understanding of fundamental particles and forces, and it bears on such issues as the origin of mass. The best efforts of theorists indicate that 20 TeV is about the minimum energy needed to have confidence that these phenomena, in whatever form they may take, will be seen at the SSC. There is broad agreement that this confidence would be lost at 15 TeV. The SSC may well make other discoveries of equal or even greater importance, but it seems to us essential that the SSC have sufficient energy so that the problem of electroweak symmetry breaking can be solved (see Appendix A).

Apart from theoretical considerations, another guide to the energy needed in a new accelerator is that it should represent a significant increase in capabilities over other accelerators. Certainly the SSC, at either 15 TeV or 20 TeV, would represent a great step beyond any accelerator now operating or under construction. However, the existing 17-mile-circumference tunnel for the Large Electron-Positron (LEP) accelerator at the European Laboratory for Particle Physics (CERN) may allow construction of an 8-TeV hadron collider (called the LHC). Such a project is being seriously considered. For an efficient and balanced international program in particle physics, the size of any new accelerator tunnel built in the United States (54 miles proposed for the SSC) should be very different from the existing LEP tunnel, and so should the corresponding accelerator energies.

We have also considered the extent to which higher luminosity can compensate for lower beam energy. Although specific experiments may be able to use luminosities above the 10^{33} cm^{-2} sec^{-1} design value, present detector technology does not allow use of higher luminosities for a broad range of experiments. The potential for upgrade of the machine to higher luminosity should be retained for future evolution of the experimental program (see Appendix A).

Finally, we are concerned that the redesign of the SSC to fit a smaller circumference, with the consequent necessity for new environmental impact studies, will incur a substantial delay in project startup and raise numerous problems.

CONCLUSION

The Subpanel concludes that the SSC Laboratory, in its current proposal, has chosen wisely among the alternatives and that the project should move forward expeditiously. We believe that lowering the SSC beam energy from 20 TeV to 17 TeV would yield an insufficient cost reduction to justify the reduction in physics reach and the initial delays involved in changing the tunnel site and redesigning the machine. Lowering the beam energy to below 15 TeV would unacceptably increase the risk of missing important new physics.

We feel strongly about the need for a flexible and reliable facility at 20 TeV for decades to come, and, therefore, we believe it would be very unwise to redesign the machine with a reduced circumference. We look forward to the unique opportunities in physics the SSC represents. We recommend that the DOE support moving ahead with the SSC project on the basis of the machine concept and tunnel footprint as currently proposed. It is imperative that the project be supported so that it can proceed on schedule.

APPENDIX A

BACKUP INFORMATION

This Appendix provides historical background, as well as additional theoretical, accelerator, and detector information.

HISTORY

For more than a decade, particle physicists have understood the importance of exploring interactions among the fundamental constituents at energies of about one trillion electron volts. Specific expectations for what might be found there have been modulated by theoretical and experimental progress, but the imperative to perform experiments in this regime—well beyond the reach of any existing accelerator—has grown ever stronger.

If the scientific need for a step to much higher energies was already apparent, in broad terms, in the late 1970s, it has required sustained effort to develop the technical means to take that step. Formal studies of the feasibility of a multi-TeV accelerator began with workshops sponsored by the International Committee for Future Accelerators at Fermilab in 1978 and at CERN in 1979. The idea of the SSC began to take shape during the Summer Study on Elementary Particle Physics and Future Facilities, organized by the Division of Particles and Fields of the American Physical Society at Snowmass in 1982, and was elaborated in workshops on accelerator and detector issues held during 1983 at Cornell and LBL. Encouraged by the dramatic discoveries at the CERN proton-antiproton collider and by the successful operation of the Fermilab Tevatron—the first superconducting synchrotron—the 1983 HEPAP Subpanel on Future Facilities recommended "the immediate initiation of a multi-TeV, high-luminosity proton-proton collider project with the goal of physics at the earliest possible date." That recommendation may be taken as the beginning of the SSC project.

In March 1986, the SSC Central Design Group, composed of physicists and engineers drawn from universities and national laboratories around the world, produced a site-independent conceptual design for a proton-proton collider with 20 TeV per beam and a peak luminosity of 10^{33} cm^{-2} sec^{-1}. That document was the basis for President Reagan's endorsement of the project and for the Department of Energy's calculation of a total project cost of $5.9 billion.

In January 1989, the DOE selected the site in Ellis County, Texas for the SSC Laboratory. A team of scientists and engineers was then assembled at the new Laboratory to develop a detailed design of the machine adapted to the site and to prepare for construction of the SSC. In October 1989, the Laboratory presented to DOE a detailed recommendation for the real estate requirements, or "footprint," for the SSC, based on the machine design and geotechnical studies. New information from the operation of the Fermilab Tevatron and from the magnet development program for the Hadron-Elektron-Ring-Anlsge (HERA) machine at the German Electron Synchrotron Laboratory (DESY) has led the SSC Laboratory to propose changes to the magnet design and injector energy. These new design choices that have been adopted on the basis of the 4 years of R&D, result in an increase of the costs.

In response to a charge from Acting Director of Energy Research James Decker to HEPAP Chairman Francis Low, the Subpanel met at the SSC Laboratory near Dallas on January 6–8, 1990. The Subpanel discussed its charge with DOE officials and heard presentations from SSC Director Roy Schwitters and his staff. We also received documents containing advice to the Laboratory from its Scientific Policy Committee, Machine Advisory Committee, Users Executive Committee, and an *ad hoc* committee on SSC physics. The Subpanel is grateful to Carlo Rubbia, Director General of CERN, for presenting us with his vision of CERN's future projects, including the possible construction of a Large Hadron Collider (LHC) in the LEP tunnel.

THEORY

To analyze the scientific potential of the SSC under various assumptions for energy and luminosity, it is convenient to divide the goals of the SSC into three categories:

(1) For the study of relatively light, copiously produced particles, the capabilities of the SSC are rather insensitive to changes in the beam energy in the range between about 20 TeV and 15 TeV, or even below. Included in this category are the search for the top quark, should it elude detection at the Tevatron, and the detailed study of the decay properties of the *b*-quark or of *W* bosons, for which the high energy and high rates of the SSC might provide special opportunities.

(2) A second category includes reactions that are strongly dependent on beam energy, but for which no threshold in energy is expected on the basis of theory. Here we think of measurements of the production rate of hadron jets at high transverse momenta, testing the predictions of quantum chromodynamics, and probing the structure of the quarks. We also include in this class the search for new gauge bosons—representing new fundamental forces—and the search for new species of quarks. For these purposes, higher energy confers a wider region over which to search, but we do not know where new discoveries are to be made. Generally speaking, decreasing the beam energy from 20 TeV to 15 TeV reduces the mass reach by 20 to 30 percent, for the same luminosity and running time. Similar comments apply to the search for new particles predicted by theories of supersymmetry to have masses up to about 2 TeV/c^2, which are expected to be produced with large cross sections at the SSC.

(3) The third category includes phenomena whose detection depends strongly upon the machine energy and luminosity in a way that can be specified in advance, either because of an energy threshold or because of small production cross sections. This includes the complex of phenomena associated with the nature of electroweak symmetry breaking, which theory tells us must appear on the 1-TeV scale for interactions among quarks or leptons or gauge bosons. Whatever the mechanism responsible for the breaking of electroweak symmetry, it is important to conduct a thorough exploration of the mass region up to about 2 TeV/c^2, which corresponds to an SSC beam energy of 20 TeV. The need to explore this regime will persist, even if a Higgs boson should be found with appreciably lower mass. To ensure that decisive information will be made available by SSC experiments, it is important to examine the most challenging possibilities. Detection of a conventional Higgs boson with a mass up to about 800 GeV/c^2 as a distinct resonance in an SSC experiment requires the full design luminosity of 10^{33} cm^{-2} sec^{-1} at the design energy of 20 TeV per beam. At reduced energies, the luminosity required for detection is increased, so that greater demands are placed on detectors.

If the Higgs boson is heavier, so that it becomes so broad that it cannot be identified as a distinct particle, or does not exist at all, then weak interactions among (longitudinal) gauge bosons must become strong at energies above about 1 TeV. This strong interaction would be manifested by multiple production of gauge bosons and by the formation of resonances among gauge bosons in the region of masses between about 1 and 2 TeV/c^2. Under the nominal operating parameters of the SSC, experiments might yield a small but significant number of characteristic events in a year of running.

If the beam energy drops appreciably below 20 TeV, one cannot guarantee sensitivity to these important new phenomena and, therefore, encounters the serious risk that the SSC might fail to deliver on its promise to elucidate the nature of electroweak symmetry breaking.

ACCELERATOR

Magnet Aperture and Injection Energy

The SSCL recommended design has an energy of 20 TeV, a luminosity of 10^{33} cm^{-2} sec^{-1}, and a 54-mile circumference. These parameters have not changed from the previous CDG design (with the exception of a 2-mile increase in the circumference). However, the injection energy and the magnet aperture have been changed, and this contributes to the cost increase from the $5.9 billion estimate.

These issues have been extensively reviewed internally by the SSCL and by external committees. Their reports were presented to the Subpanel. The main reasons for the changes were that in the last 2 years much has been learned about the behavior of superconducting magnets at low fields, i.e. at the injection energy. Experience and beam measurements at the Tevatron, and magnetic measurements of the dipole magnets being built in Europe for the HERA project, show unexpected behavior of the leftover circulating currents in the superconductor, so called "persistent" currents. These produce field errors that require correction during injection. After ramping down from high energy and high fields to injection energy, the "persistent" currents behave in a nonuniform manner and, indeed, vary with time, necessitating continuous changes of corrections during injection and the early part of the ramp to high energy. Improvements in numerical simulation have allowed studies of the long-term beam behavior under realistic operating conditions, and these new tools have been used to make a more dependable evaluation of the impact of field errors.

The increases of injection energy and the aperture size will substantially alleviate these difficulties and improve the operability of the SSC. These changes allow the machine to be commissioned more rapidly, thereby, avoiding costly delays and allowing more reliable operation. We concur with the SSCL in the logic of making these changes in light of this new information.

Cost Reduction Possibilities

The only viable option to make a significant reduction in the capital cost of the SSC is to reduce the beam energy and the circumference. Reducing the beam energy without a reduction of circumference (the "missing magnet" scheme) would not reduce the cost sufficiently to warrant its impact because there are little savings on the complex interconnections and other technical components. The later upgrade by filling in the missing

magnets would be expensive and would require a major interruption of the experimental program. The Subpanel believes that this staged approach to a 20 TeV facility would be much more costly than the present plan.

As an example of simultaneous reduction of circumference and energy, the Subpanel was presented with a hypothetical design at 17 TeV, the cost of which was less than the recommended design but still greater than the $5.9 billion. This represents a real, nonrecoverable reduction in the physics reach of the project. A factor which argues against this approach is that a smaller ring would require a new footprint and environmental study, causing delays which implies increased cost. There was some discussion of operating a smaller 17-TeV ring at lower temperatures to raise its energy to perhaps 20 TeV. This probably requires changes in the magnet and cryogenic systems, again increasing cost. The Subpanel believes that these factors effectively nullify the apparent cost savings and does not recommend following this direction.

We discussed other areas of potential cost savings, including initial luminosity reduction or a reduction in initial experimental capability. The Subpanel believes that a reduction in luminosity in the early stages of operation would not be excessively harmful provided that the luminosity can later be easily increased. Unfortunately, such initial luminosity reductions do not appear to provide for cost reductions. Some money could be saved by initially preparing only half the number of experimental areas and detectors, but this would reduce the initial value of the project in a major way. In addition, later installation of this experimental capability would be a major interference with the on-going program. We recommend neither of the above schemes.

Luminosity and the LHC

CERN, in Geneva, Switzerland, is considering the possibility of a Large Hadron Collider (LHC) to be built in the existing 17-mile-circumference LEP tunnel. This machine could have a maximum beam energy of the order of 8 TeV. With its current design energy of 20 TeV, and assuming a similar luminosity, the SSC can explore a wide and potentially exciting range of physics that could not be reached by the LHC. A substantial reduction in the SSC energy would clearly reduce its uniqueness.

A comment is needed on the luminosities of the two machines. Dr. Carlo Rubbia, the Director General of CERN, presented an LHC design concept for a luminosity of 4×10^{34} cm^{-2} sec^{-1}, a factor of 40 higher than that of the SSC. This raises two questions:

1) Is the SSC luminosity intrinsically lower than that of the LHC? We have studied this question in some detail and conclude that there is no significant difference in the potential luminosities of the two machines. In addition, there are ways, in principle, to attain even higher luminosities, if desired.

2) Can either laboratory build detectors that are capable of exploring luminosities above 10^{33} cm^{-2} sec^{-1}? On this question there is no simple answer. A general-purpose detector, as now conceived, cannot operate above a luminosity of about 10^{33} cm^{-2}sec^{-1}, and, indeed, it was this consideration which led to the SSC design specification. But it is at least possible that special purpose, more limited, detectors (for instance one that detects only muons outside a metal shield) could do some experiments at, or even above, a luminosity of 4×10^{34} cm^{-2}sec^{-1} as discussed for LHC (see following Detector section).

In view of the above, we encourage the SSCL to continue its study of possible higher luminosity configurations. Nothing should be done to the current proposal that would preclude future upgrades to achieve such high luminosities.

DETECTORS

The SSC represents a large step beyond existing accelerators and will support a broad program of experimentation which will extend for decades into the 21st Century. Thus the design includes the construction of four experimental halls that can accommodate a diverse array of detectors and provide widely varying operating conditions that can be adjusted to experimental needs. Experiments mounted at the SSC will carry out searches for new particles and new phenomena—both predicted and unexpected—and will make precise measurements to test the validity of our current understanding. Large, multi-purpose experiments may carry out many measurements and searches at the same time. Other experiments may bring specialized characteristics to bear on a restricted set of issues. Experience has shown that the experimental program is best served with several complementary experiments utilizing the machine simultaneously.

The techniques for particle detection at SSC energies and luminosities have been discussed at numerous workshops. A number of detector configurations are now being investigated within the experimental community in anticipation of proposal preparation. The SSC places severe demands on the detectors because of the high event rates generated by the machine. At the design luminosity of 10^{33} cm^{-2} sec^{-1}, about 100 million events per second will be produced at each interaction region of which perhaps 10-100 million per year will be recorded for future use.

The general technique to reduce the 100 million events per second to a manageable level by selecting events of interest is well established. Tests of the Standard Model based on such selected data samples form the basis for the design of the large multi-purpose detector systems that will be the backbone of the SSC experimental program.

Present detector technology, extrapolated to the SSC era and supported by a vigorous R&D program, is expected to allow multi-purpose detectors to operate up to luminosities of 10^{33} cm^{-2} sec^{-1}. The limit of 10^{33} cm^{-2} sec^{-1} luminosity arises naturally for many experiments since, above this value, multiple events occur each time two beam bunches cross. On the other hand, special purpose detectors can probably be operated at an order of magnitude higher luminosity, and, in some cases, even higher, especially for experiments detecting muons or neutrinos.

It is not possible to give simple answers to the assessment of the impact of energy and luminosity variation on detector systems. In general, the energy and momentum scales associated with the detection of the decay fragments of a new massive particle are set by the mass of such a particle and are only weakly dependent on machine energy. No significant change in detector size or complexity is required for variations in the SSC beam energy in the range of 15 to 20 TeV.

On the other hand, the high flux of secondary particles produced by the proton-proton interactions can obscure signals of interest, degrade resolutions, and cause significant radiation damage in the detector components. For this reason, detector performance is very sensitive to luminosity increases in the machine, since the associated particle flux is directly proportional to luminosity. Thus, luminosity increases in the machine can compensate for decreased collider energy only for a narrow range of physics topics which can be studied by appropriate special-purpose detectors.

In general, to maintain constant physics potential for a detector at increased luminosity levels, the problems posed by the high particle flux, higher radiation levels, and multiple interactions must still be addressed. Indeed, to utilize 10^{33} cm^{-2} sec^{-1} luminosity strains the limits of current technology as far as the number of channels, speed of electronics, and radiation hardness are concerned. However, detection techniques required to take advantage of future luminosity upgrades are possible, in principle, and R&D should be pursued vigorously.

On the basis of these considerations, initial operation of a 20 TeV per beam machine at a design luminosity of 10^{33} cm^{-2} sec^{-1} in the late 1990s is projected to be the best match to particle detection capabilities. The potential for upgrading the machine to higher luminosity should be retained for future evolution of the experimental program.

APPENDIX B

Department of Energy
Washington, DC 20585

DEC 21 1989

Professor Francis E. Low
Chairman, HEPAP
Laboratory for Nuclear Science
Massachusetts Institute of
Technology
Cambridge, MA 02139

Dear Professor Low:

The Superconducting Super Collider (SSC), a major scientific initiative of this Administration, will ensure continued progress in the field of high energy physics into the future. The SSC, which has recently been approved for construction, is now undergoing final design. In attempting to optimize the design, there are some practical financial constraints which must be considered. We would like the High Energy Physics Advisory Panel (HEPAP) to provide us with some advice on the range of useful machine parameters in order to complete the design phase of the facility.

The advice we are seeking focuses on the physics research to be done at the SSC. On the one hand, we understand the optimum design for physics research is that which provides the highest energy and luminosity technically feasible. On the other hand, budget constraints may require the design to be less than the optimum. Are there some lower bounds on the technical parameters below which the physics research to be undertaken would be scientifically unimportant, marginally productive, or duplicative of ongoing or proposed work elsewhere? How much physics potential would be lost by reducing the machine energy below 20 TeV? Below 17 TeV? Below 15 TeV? What are the energy/luminosity tradeoffs? To what extent is luminosity limited by the detectors?

The Director of the SSC Laboratory recently convened an Ad Hoc Committee on SSC Physics to examine the impact of changing energy and luminosity. A copy of their report, "Report of the Ad Hoc Committee on SSC Physics," SSC-250, December 1989, is enclosed and you may wish to use it as a starting point for your deliberations. We ask that you convene a "blue-ribbon" subpanel to review and comment on the above questions.

For the Department of Energy to use the results of your deliberations in a timely manner, it is imperative for HEPAP to provide us with a preliminary

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report by January 12, 1990. Therefore, we would like the subpanel to meet before then, prepare a report, and discuss it at a HEPAP meeting to be held January 12, 1990.

Thank you for your cooperation.

Sincerely,

James F. Decker
Acting Director
Office of Energy Research

Enclosure

APPENDIX C

MEMBERSHIP

1990 SUBPANEL ON SSC PHYSICS

S. Drell, Chairman	-	Stanford Linear Accelerator Center
W. Brinkman	-	AT&T Bell Laboratories
A. Chao	-	SSC Laboratory
J. Cronin	-	University of Chicago
E. Henley	-	University of Washington
L. Lederman	-	University of Chicago
T. Lee	-	Columbia University
R. Palmer	-	Brookhaven National Laboratory
E. Paterson	-	Stanford Linear Accelerator Center
C. Quigg	-	Lawrence Berkeley Laboratory
N. Ramsey	-	Harvard University
J. Sandweiss	-	Yale University
J. Siegrist	-	Lawrence Berkeley Laboratory
S. Weinberg	-	University of Texas
V. Weisskopf	-	Massachusetts Institute of Technology
P. K. Williams, Executive Secretary	-	U.S. Department of Energy

Secretary WATKINS. Mr. Chairman, I would hope you would call before your committee particularly Dr. T.D. Lee, who is—who could put the SSC in the context I tried very ineffectively to do today. He can put this excitement of what is possible, what the American people can't see, which is as exciting as space, way down deep inside the atom, looking at the various particles and the very earliest part of the universe exploding.

That is every bit as important.

Mr. BEVILL. We will certainly work him in, if you will have him contact the staff.

Secretary WATKINS. Dr. Sidney Drell was the chairman of that study.

Mr. BEVILL. All right, we will do that.

And, Mr. Secretary, last year we did not get the testimony returned to the committee for some time. We need that within three days. Whoever handles that within your Department. I wish they would get it back quickly.

Secretary WATKINS. I did not know that. I will get my own tickler on that in my own office. We will see if we can do better.

Mr. BEVILL. This panel certainly supports you and your leadership, and what you in the Department of Energy are doing, and your new initiatives particularly are impressive.

So, thank you very much, and Dr. Decker and Mrs. Smedley, all three of you, thank you very much. We will stand adjourned until 10 tomorrow.

[The questions and answers for the record and the statement of Admiral Watkins follow:]

REPROGRAMMINGS

Mr. Bevill. Mr. Secretary, The Committee is pleased to hear you take a strong stand on a number of difficult issues. I am extremely interested in your initiatives in the following areas: waste management; solar and renewables; education, Defense facility cleanup; review teams and boards; Savannah River and Rocky Flats restart; SIS restriction; and child care centers.

I am concerned, however, that these initiatives are proposed to begin in FY 1990 and the Department has not received the approval of Congress to change from the way the funds were appropriated.

The Committee has worked well with the Department in the past, but I want to make it very clear that the funds are to be used for the purposes appropriated unless a reprogramming has been proposed and accepted.

I am also concerned with your proposal to eliminate or greatly reduce a number of programs long supported by the Committee such as ocean energy programs and geopressure programs.

I would like your assurances that you will not divert the funds appropriated without an approved reprogramming.

Mr. Secretary, I would like you to discuss these and any other Department initiatives and specifically address the actions you have taken to assure that funds are not being redirected without Congressional approval.

Mr. Secretary, The Department has its reprogramming rules published in DOE Order 5160.A. These rules have been coordinated with this Committee. I would like your personal commitment that the Department will abide by those reprogramming rules.

Admiral Watkins. The Department is fully aware of the interest Congress has in the execution of our programs, and I am committed to keeping Congress fully informed of any proposed changes. In the last several days the Department has provided the Committee with a number of reprogramming notifications, and I can assure you that we will take no action without full consideration of the Committee's views. The procedures outlined in DOE Order 5160.A are being revised to reflect the fact that I want personally to approve and sign each proposed reprogramming to ensure that only the most necessary redirections of appropriated funds are submitted.

Mr. Bevill. There has also been discussion about reducing the capabilities of the SSC sufficient to offset any cost increases. What is the status of any decision to rescope the technical capabilities of the project?

Admiral Watkins. We have decided to proceed with the SSC at the 20 TeV energy level and to accept the Laboratory's recommendation to increase the injection energy from 1 TeV to 2 TeV and to increase the magnet coil aperture from 4 centimeter to 5 centimeter. We are very concerned about these cost increases and while we have accepted these design changes we have instructed the Laboratory to reduce costs as much as possible.

Mr. Bevill. With respect to foreign participation in the SSC, what do you regard as the minimum percentage of the project that should be funded from foreign and non-Federal sources?

Admiral Watkins. The Administration goal consistently has been for one-third of the requested total project costs to come from non-Federal sources. The state of Texas will contribute up to $1 billion for the construction of on-site facilities and other SSC systems. The Department is seeking the remainder from collaborative arrangements with other nations.

Mr. Bevill. What is the status of the commitment of foreign funds to the project. Exactly what countries have agreed to provide what funds?

Admiral Watkins. The only country that has signed an agreement to build equipment for the SSC is India. We expect to start sending out negotiating teams in the next few months to visit all other countries that might contribute components for the SSC.

Meanwhile, as we are preparing for the start of government-to-government negotiations, the ground is being prepared for such negotiations by the international community of physicists. They have been kept fully abreast of progress in the SSC program through international conferences on the physics research opportunities presented by the SSC, through participation in various advisory panels to the SSC Laboratory, in the development of experimental programs for the SSC, and in the sponsoring of national workshops which seek to define national involvement in the SSC.

Mr. Bevill. If a foreign country agrees to make a contribution to the SSC by providing the high technology components that they design and build in their country, how will the project contribute to the technical excellence of this country?

Admiral Watkins. Foreign contributions to the SSC will contribute to the technical excellence of the U.S. in two ways.

First, much of the high technology equipment will be built in the U.S. and U.S. companies will gain technical excellence in the high-technology fields linked to the SSC.

Second, in the case of donations, the design of technical components would have to be done either by the SSC Laboratory itself or as a collaboration between the SSC Laboratory and the donating organization. Typically, technical excellence is achieved by a sharing of ideas, concepts and experiences among internationally renowned experts. The SSC Laboratory will have to be as familiar with any high technology components as the contributor so that they can be integrated into much larger systems. It should also be noted that the operation of the SSC accelerator complex itself will undoubtedly be one of the great technological achievements of the twenty-first century and it will be primarily a U.S. achievement.

Mr. Bevill. What is the status of the contribution of funds from the State of Texas?

Admiral Watkins. The Department of Energy and the Texas National Research Laboratory Commission (TNRLC) have discussed the $1 billion committed in their proposal for the SSC sited in Texas. These discussions have resulted in general agreement on the proposed allocation of the funds for construction, utilities, research and development, and science education. Although a schedule for their contribution has not yet been agreed to, we are in the process of developing a Memorandum of Agreement (MOA) with the TNRLC to define responsibilities and actions necessary to implement the Texas proposal. It is intended that this MOA will include a schedule for the Texas contribution and it will be completed by about May 1990. We expect to release the Laboratory footprint soon and Texas will issue bonds for the purpose of providing funding for the SSC.

Mr. Bevill. When will we know exactly how much the state will contribute, when the contribution will be made, and what restrictions are imposed on the use of the money?

Admiral Watkins. In accordance with the Texas proposal to site the SSC in Texas, a total of $1 billion of Texas funds for construction and utilities ultimately will be transferred directly to the Department of Energy. The Department is negotiating a Memorandum of Agreement (MOA) with Texas, which will include a schedule for the Texas contribution and an agreed upon allocation of the funds. Once this agreement is reached, there will be no additional restrictions on the funds. It is expected that this MOA will be completed by about May 1990.

IMPROVED OPERATION OF DEFENSE FACILITIES

Mr. Bevill. Mr. Secretary, when you appeared before this Committee last year, you asked for one year to demonstrate that you could improve the management of the Department's defense nuclear facilities. What has been accomplished in the last year to improve operation of defense facilities?

Admiral Watkins. I would say much has been done to improve the Department of Energy's (DOE) Defense Programs facilities over the past year. First, at Savannah River we found hardware and management problems which needed to be resolved before we restart those production reactors. We now have a plan in place to resolve these problems and are instituting the discipline with our new operating contractor, Westinghouse, so these reactors can be operated safely. At Rocky Flats, we also found problems that needed to be resolved prior to resumption of operations. We now have identified the required fixes and have a new operating contractor in place with an understanding that the first priority is to operate the facility safely in compliance with environmental laws and regulations.

Throughout DOE's defense program's complex, we are doing much to improve operations at all facilities. As part of the Ten Point Plan I announced in June, we are aggressively moving toward full accountability and compliance with environmental, safety and health laws. We have put teeth into this emphasis through restructuring the existing system of award-fee contracts so that compliance with environmental, safety, and health laws and concerns constitutes at least 51 percent of the semi-annual evaluations. As indicated in the Ten Point Plan, we have established "tiger teams" to conduct

environmental compliance audits; we have moved to strengthen the technical capabilities of line management and oversight personnel; have mandated compliance with OSHA standards at our facilities; have improved DOE procedures for compliance with the National Environmental Policy Act; and have established a new management team within the Department's Office of Defense Programs to emphasize safety over production. So, Mr. Bevill, we have done many things over the past year and while the fruits of our labor are not complete, we have set forth a new culture at the Department of Energy which will allow this Department to meet its responsibilities in a manner consistent with the laws of this country.

ENVIRONMENTAL IMPACT STATEMENTS

Mr. Bevill. The Department announced that an Environmental Impact Statement (EIS) would be prepared for the Defense Modernization Plan and for the Five Year Environmental Restoration and Waste Management Plan. Are you continuing to perform the activities proposed in each of these plans before the EIS is completed? If so, of what use is the EIS?

Admiral Watkins. Under the regulations of the Council on Environmental Quality for implementing the National Environmental Policy Act (NEPA), actions that would be addressed by either the Defense Modernization Plan or the Five Year Environmental Restoration and Waste Management Plan may proceed prior to completion of a Programmatic Environmental Impact Statement (EIS) if they meet three criteria: (1) the action is justified independently of the program for which the programmatic EIS is to be prepared; (2) the action is accompanied by an adequate EIS or other appropriate NEPA documentation and; (3) the action will not prejudice the ultimate decision of the programmatic EIS. It is the Department's intention to follow these regulations and criteria in the planning and implementation of its environmental restoration, waste management, and defense complex modernization activities. For many of these activities, justification exists on the basis of compliance with existing laws or regulations or Departmental Orders to protect worker and public health and safety and the environment. In addition, we have some immediate needs to upgrade the maintenance, safety, and productivity of the facilities throughout the complex which will continue over the next several years. In any case, appropriate NEPA documentation will accompany Departmental activities, including an EIS where it is determined that an activity is a major Federal action that could significantly affect the environment. To this end, I have

recently issued Secretarial Notice SEN-15-90 National Environmental Policy Act to all Departmental elements. This notice is intended to assure full incorporation of NEPA requirements early in project planning and serve the goal of environmental "full disclosure" as a furtherance of my 10-point initiative of last summer. Finally, the Department recognizes the importance in completing these two programmatic EIS's so that planning for the Defense Modernization Project and the Environmental Restoration and Waste Management Five Year Plan implementation is based on a thorough consideration of the system-wide impacts of broad policy alternatives.

SCHEDULES FOR SAVANNAH RIVER REACTOR RESTART
AND RESUMPTION OF ROCKY FLATS PLUTONIUM OPERATIONS

Mr. Bevill. Currently, the Savannah River reactors and the Rocky Flats Plant are shutdown. What is the latest schedule for restart of these facilities? Please describe the issues which need to be resolved before this decision can be made.

Admiral Watkins. The current schedule for the Savannah River reactors contemplates that the first reactor will achieve criticality and low power testing late in the third quarter of calendar year 1990 and with power operation in the fourth quarter of calendar year 1990. The other two reactors would follow at 3 month intervals. I will be reviewing the restart effort during the next several weeks and will announce a more specific restart schedule in April.

For Rocky Flats, the current schedule calls for the resumption of plutonium operations in the second quarter of calendar year 1990. Beginning with aqueous plutonium recycle processes in Building 771, operations are planned to resume sequentially until full plutonium operations are restored by the end of the third quarter of calendar year 1990.

The objectives of the suspension of operations at the Rocky Flats Plant have been to allow the new operating contractor, EG&G, to install its own management team, to gain a comprehensive understanding of plant operations, to implement some operational changes in terms of formality and discipline, and to increase the margin of safety in plutonium operations. Several activities

pertinent to overall site operations will be completed before resumption of plutonium operations, including evaluation of management effectiveness; strengthening the process for self assessment; strengthening the process for feedback of lessons learned; and conducting a corporate review for readiness.

Specific resumption issues to be resolved for each facility before operations are resumed are contained in a list I would like to submit for the record. (The information follows:)

ACTIONS TO BE COMPLETED FOR EACH FACILITY

PRIOR TO FULL RESUMPTION OF OPERATIONS

ROCKY FLATS PLANT

1. Red line all safety system drawings.
2. Verify that all safety-related alarms and indicators are functional.
3. Verify the competence of operators.
4. Review safety Analysis Reports and Procedures.
5. Verify that the condition of systems and equipment is acceptable for resumption of operations.
6. Verify compliance with environmental permits and the safety envelope as defined by the Safety Analysis Reports and the Operational Safety Requirements.

SAVANNAH RIVER SITE REACTORS

1. Resolution of technical issues. (e.g. ultrasonic testing of reactor tank, seismic upgrades)
2. Training and qualification of operators.
3. Completion of Safety Evaluation Report.
4. Operational Readiness Review.
5. Completion of Environmental Impact Statement.

EFFECT OF DELAYS ON DOD WEAPONS REQUIREMENTS

Mr. Bevill. At what point will delays in restart of Savannah River and Rocky Flats impact the Department's ability to meet DOD weapon requirements?

Admiral Watkins. This issue is classified and will be discussed in the closed hearings scheduled for March 12 and 13 with Defense Programs.

OVERSIGHT AND REVIEW OF DOE ACTIVITIES

Mr. Bevill. These are multiple layers of oversight and review occurring in the Department today -- tiger teams, NAS reviews, advisory committees, and the Defense Nuclear Facility Safety Board. Can you assure the Committee that these multiple reviews are effective and productive rather than duplicative and disruptive?

Admiral Watkins. It is my strong belief that the present structure for conducting oversight reviews of Departmental program and field operations is both effective and efficient.

Early in my tenure as Secretary of Energy I found it necessary to establish a baseline review of compliance by Departmental programs and field operations with Departmental environment, safety and health policy, and Federal laws and regulations. To accomplish these baseline reviews, I set up a "Tiger Team" review concept to conduct in-depth reviews of field facilities and operations on a priority basis. These reviews will continue until conditions at all significant facilities have been determined. The findings of the Tiger Team reviews have been the basis for many necessary corrective actions.

In the meantime, I announced a new concept of line management responsibility and accountability for program management. Under this concept, I will look to program managers to ensure that their programs are conducted in compliance with all environmental, safety and health laws and regulations. In addition, to assure that we have consistent program execution with respect to nuclear safety policies and regulations, I have established an Office of Nuclear Safety to provide internal, independent oversight of program and field activities on a continuing basis.

All these internal Departmental activities will be supplemented by use of the Advisory Committee on nuclear facility Safety as an external source of independent review of Departmental operation both nuclear and non-nuclear.

Of course, the Defense Nuclear Facilities Safety Board is charged by law to conduct independent reviews of specific Departmental Defense facilities. The Board is currently in the process of establishing operations as required by law. We, in the Department, have been supportive of this organizational effort and have begun negotiation of an Memorandum of Understanding with the Board. We will cooperate in the future to assure safe operation of all Departmental nuclear facilities.

This comprehensive internal and external management and independent oversight should assure DOE's compliance with applicable environmental, health and safety requirements. DOE can only be considered successful if we can carry out our mission without insult to the environment or injury to public and worker health and safety.

FUTURE OF HANFORD SITE

Mr. Bevill. The Hanford site in Richland, Washington, has been gradually phased out of the nuclear material production function. How has this impacted that site and what future role do you see for the Hanford reservation?

Admiral Watkins. Although Hanford will continue to support materials production requirements through recovery of plutonium from scrap and spent fuel, the primary emphasis at the site has shifted to the Environmental Management program. The funding for the Nuclear Materials Production program at Hanford will decrease only slightly from $230 million for FY 1990 to $220 million for FY 1991. However, for the same period the Environmental Management program funding will increase by approximately 55 percent, from $436 million to about $677 million.

The Hanford site is very strongly focused on waste management and environmental restoration activities. The Department has signed an agreement with the Environmental Protection Agency and the State of Washington addressing cleanup and permitting activities at the site. This agreement commits to a 30 year program for remediating Comprehensive Environmental Restoration, Compensation and Liability Act (CERCLA) sites and proceeding with the treatment and disposal of Resource Conservation Recovery Act (RCRA) wastes at the site.

To accomplish milestones in the agreement, new facilities will be needed for retrieving, storing, treating and/or disposing of hazardous, radioactive and mixed wastes.

Among the facilities needed are low-level and high-level radiation laboratories for characterization, radioactive and mixed waste disposal trenches, a Waste Receiving and Processing Facility, the Hanford Waste Vitrification Plant, B Plant (tank waste pretreatment facility), grout disposal vaults, as well as retrieval and/or treatment systems for the single-shell tank waste.

DEFENSE ACTIVITIES

Mr. Bevill. The Department recently announced a proposal to increase the accountability of its contractors and examine the full indemnification policy under which DOE and its contractors have operated. What is the status of this proposal? What concerns have been voiced by DOE's current contractors?

Admiral Watkins. On January 26, 1990, the Department published a Notice of Proposed Rule in the Federal Register (55 FR 2796) which is intended to clarify the responsibilities of its Management and Operating contractors and provide additional incentives to improve the accountability of these contractors. The comment period will run for 60 days. The DOE's objective in proposing the new rule is to emphasize the importance it places on its contractors for excellent performance, particularly in the area of environment, health, and safety in operating DOE facilities.

This rulemaking specifies conditions under which the M&O contractors assume the risk for certain avoidable costs. The proposed rulemaking affects only those M&O contractors that receive a profit under their contracts with DOE. I would like to insert for the record the proposed nonreimbursable costs.

(the information follows)

PROPOSED NONREIMBURSABLE COSTS

- Costs and expenses resulting from damage to government property solely as a result of ordinary contractor negligence in extraordinary, nonroutine circumstances.

- Losses of government property resulting from theft, embezzlement or unauthorized use.

- Losses due to ordinary negligence by the contractor in carrying out well-understood, non-experimental work under the contract. These unallowable expenses refer to the costs necessary to correct the error and accomplish the assigned task.

- Fines, penalties, judgments and other litigation costs arising from contractor noncompliance with environmental laws, within the contractor's ability to have complied.

- Judgments and other litigation costs stemming from common-law contractor negligence or misconduct giving rise to simple tort liability to third parties.

- Civil and criminal penalties assessed pursuant to the Price-Anderson Amendments Act of 1988, and costs of litigation involving such penalties. M&O contractors would continue to be indemnified against public liability for a nuclear incident as specified under Price-Anderson. (Under the 1988 Act, the Secretary of Energy is authorized to impose civil fines on certain government contractors for violations of applicable DOE nuclear safety rules, regulations and orders.)

- Any other costs that stem from the willful misconduct or lack of good faith of an M&O contractor supervisory or management employee.

- Costs of insurance for nonreimbursable avoidable costs.

DOE has received very few comments at this time and of those received none have been from current M&O contractors.

Under the proposed rulemaking, DOE would continue to indemnify M&O contractors against non-nuclear risks for actions within the scope of work of the contract.

In view of the risks and uncertainties unique to these government facilities, a ceiling would be placed on the liability of the contractor for avoidable costs incurred under this proposal. This ceiling would be equal to the maximum potentially available award fee for the six month evaluation period. The contractor would be required to provide a guarantee that it would satisfy any potential future liability discovered after the award fee period or after the contract is terminated.

The DOE's current contractors have expressed concern that they are being asked to accept risk for activities that they have little control over. They submit that they work in outdated DOE facilities with no control over budget decisions, which would make these facilities safer to run. They have also pointed out that the fee currently received is very small in comparison to the risk they would have to take under the new rule. The DOE, however, has under internal review a revised award fee policy which is intended to recognize the increased risk and to encourage better performance in the areas of environment, safety and health.

OPENING OF THE WASTE ISOLATION
PILOT PLANT

Mr. Bevill. The opening of the Waste Isolation Pilot Plant (WIPP) has continued to slip. What issues must be resolved before a decision can be made to open the facility?

Admiral Watkins. The Department is tracking the critical issues pertinent to WIPP in a Decision Plan which is updated monthly and issued by the Secretary to Congress and to effected States, other Federal agencies, and oversite/interest groups. On June 15, 1990, the Secretary will evaluate the status of all remaining prerequisites and could announce the projected date for the initiation of the Test Phase with actual waste. Some of the critical issues which must be resolved before WIPP can initiate the Test Phase include: the granting of the No-Migration Variance Petition by the Environmental Protection Agency; approval of the Final Safety Analysis Report addendum to include the Test Phase; obtaining Legislative or Administrative Land Withdrawal; and issuance of the Record of Decision for the Supplemental Environmental Impact Statement.

OPTIONS FOR PLUTONIUM PROCESSING

Mr. Bevill. What options other than renovating Building 371 at Rocky Flats are being explored for plutonium processing? Are there existing facilities in the weapons complex which could be used?

Admiral Watkins. Options for plutonium processing other than the proposed renovation of Building 371, the plutonium recovery facility, include continuing limited processing operations at Rocky Flats; constructing a new facility at another location for processing all plutonium residues; or processing all plutonium parts from retired weapons in a new facility at another location, and recovering process residues at the Rocky Flats Plant in Building 371, which represents a more limited role with less renovation of Building 371 than proposed. These options will be evaluated in the Environmental Impact Statement to be prepared for renovating Building 371.

There are other facilities in the weapons complex which can process plutonium. These other facilities are located at the Hanford Site, at the Savannah River Site, and at the Los Alamos National Laboratory. These facilities have assisted in processing plutonium residues from the Rocky Flats Plant for more than five years and they are continuing to do so. None of these facilities, either individually or collectively, has either the capability or the capacity to process all of the many diverse residues that have been and continue to be generated from recycle and manufacturing operations at the Rocky Flats Plant.

ORGANIZATION

Mr. Bevill. With the exception of the Assistant Secretaries and the Office of Energy Research, please describe the size and role of each office reporting directly to the Secretary. Please indicate which of these offices were established by law and give the legal authority for these offices not established by law.

Admiral Watkins. In addition to the Assistant Secretaries and the Office of Energy Research, details on the remaining organizations that report to the Office of the Secretary are provided in a table which I would like to insert in the record.

(the information follows)

DATA ON ORGANIZATIONS WHICH REPORT TO THE SECRETARY

ORGANIZATION	ROLE	FY 1990 FTE ALLOCATION AS OF 2-24-90	ESTABLISHING AUTHORITY
o General Counsel	- Provide legal services and counsel to the Secretary and the Department	162	- Department of Energy Organization Act (P.L. 95-91), Sec. 202
o Inspector General	- Performs financial and management audits; conducts inspections and investigations to prevent/detect possible fraud, abuse and irregularities	240	- Inspector General Act Amendments of 1988 (P.L. 100-504) Sec. 102
o Economic Regulatory Administration	- Manages Departmental audit and administrative litigation functions under the Emergency Petroleum Allocation Act of 1973	117	- Department of Energy Organization Act (P.L. 95-91) Sec. 206
o Energy Information Administration	- Develops and operates energy information programs and provides timely energy information to the Executive Branch, Congress, State governments and the public	469	- Department of Energy Organization Act (P.L. 95-91) Sec. 205

o Bonneville Power Administration	- Markets power from the region's Federal hydrogenerating projects to assure a reliable electric energy system in the Pacific Northwest	3230	- Department of Energy Organization Act (P.L. 95-91) Sec. 302(a)(2)
o Western Area Power Administration	- Markets power and energy generated at Federal hydroelectric generating projects in 15 western states to wholesale power customers	1383	- Department of Energy Organization Act (P.L. 95-91) Sec. 302(a)(3)
o Office of Civilian Radioactive Waste Management	- Manages development of an integrated waste management system for the disposal of high-level radioactive waste and spent nuclear fuel	133	- Nuclear Waste Policy Act (P.L. 97-425) Sec. 304
o Office of Minority Economic Impact	- Advises the Secretary regarding the effect of DOE policies, regulations and other actions on minorities and minority business enterprises	11	- National Energy Conservation Policy Act (P.L. 95-619) Sec. 641
o Office of Small and Disadvantaged Business Utilization	- Acts as advocate for small businesses in their dealings with DOE	8	- Small Business Investment Act (P.L. 95-507) Sec. 211
o Office of Alcohol Fuels	- Responsible for the Department's assistance programs for alcohol fuels production and encourages the development and use of alcohol fuels	3	- Energy Security Act (P.L. 96-294) Sec. 220
o Office of Environmental Restoration and Waste Management	- Manages Departmental programs, projects and related activities documented in the Environmental Restoration and Waste Management 5-year Plan	107	- By authority of the Secretary of Energy as provided in Sec. 643 of the Dept. of Energy Act (P.L. 95-91)

o Board of Contract Appeals	- Adjudicates appeals involving contract related disputes	8	Same as above
o Office of New Production Reactors	- Responsible for program to design and construct new production reactor capacity for weapons materials	105	Same as above
o Office of Policy, Planning and Analysis	- Responsible for development of National Energy Strategy; conducts energy policy analyses and evaluates Departmental program vis-a-vis National Energy Strategy	89	Same as above
o Office of Public Affairs	- Provides Press Services and public affairs support to the Secretary and Departmental programs	22	Same as above
o Office of Nuclear Safety	- Conducts independent internal oversight of Departmental nuclear safety policy implementation and enforces nuclear safety regulations under Price-Anderson provisions	40	Same as above
o Office of Procurement and Assistance Management	- Responsible for policy and operational support in all Departmental contracting, grants and financial assistance activities	1219	Same as above
o Office of Financial Management and Controller	- Responsible for policy and operational support in budgeting and financial management activities of the Department		Same as above
o Office of Administration and Human Resource Management	- Responsible for policy and operational support in Departmental organization and administrative management activities		Same as above

o Office of Hearings and Appeals	- Responsible for adjudication of administrative law issues of the Department except those assigned to FERC and the Board of Contract Appeals	89	Same as above
o Operations Offices	- Execution of assigned programs and project activities including management of on-site and off-site contractors		- Same as above
- Albuquerque		1360	
- Chicago		571	
- Idaho		387	
- Nevada		380	
- Oak Ridge		700	
- Richland		334	
- San Francisco		312	
(Savannah River Operations Office reports directly to the Assistant Secretary for Defense Programs per Secretary of Energy Notice, SEN-6-89, May 19, 1989)			

OFFICE OF THE SECRETARY ON BOARD STAFFING

Mr. Bevill. Please provide the name of each employee reporting directly to the Office of the Secretary, the Office of the Deputy Secretary and the Office of the Under Secretary. Please include their grade, function and source of funding.

Adm. Watkins. The names, grades, and functions of all personnel reporting directly to the Office of the Secretary, the Office of the Deputy Secretary and the Office of the Under Secretary are shown in a table which I would like to insert in the record. The source of funding is the Departmental Administration appropriation.

(the information follows)

OFFICE OF THE SECRETARY

Name	Grade	Function
James D. Watkins	EX-I	Secretary of Energy
Polly L. Gault	SES-6	Chief of Staff
Stephen L. May	SES-2	Special Assistant to the Secretary
Nancy F. Wolicki	SES-1	Special Assistant to the Secretary (Counselor)
David Durham	SES-1	Special Assistant to the Secretary (Environment)
Robert Mathias	GM-15	Executive Assistant to the Secretary
Ruth Burns	GM-14	Special Assistant to the Chief of Staff (On detail from PE NTE 6/90)
Macy Moy	GS-11	Secretary to the Secretary
Patricia Faith	GS-12	Secretary to the Chief of Staff (On detail from CP)
Patti Mae Wood	GS-09	Administrative Specialist
Alberto D. Leyson	GS-09	Staff Assistant to the Secretary
Angela Vaughn	GS-09	Receptionist

Joseph E. Bullock	WG-08	Chauffeur
ValJean Bynum	GS-08	Secretary to the Counselor
Brian Yablonski	GS-05	Staff Assistant (On detail to the White House)

OFFICE OF SCHEDULING & LOGISTICS
(Also responsible for schedules of Deputy and Under Secretary)

Victoria Thornton	GM-15	Director of Scheduling and Logistics
Cheryl Alford	GM-14	Staff Assistant to the Secretary (Scheduling)
Patricia Shelor	GS-13	Staff Assistant to the Secretary (Scheduling) (On detail from CP)
Natalia Wieschenberg	GS-12	Staff Assistant to the Secretary (Scheduling) (1 yr temp appt NTE 10/7/90)
Kathryn Hollis	GS-11	Staff Assistant to the Secretary (Scheduling)
Margo Payne	GS-09	Staff Assistant to the Secretary (Scheduling) (On detail from CP)
Suzanna Tashiro	GS-07	Staff Assistant to the Secretary (Scheduling)
Carolyn Wallace	GS-07	Secretary to the Staff Assistant (Scheduling)
Hoang Thu-Huong	GS-04	Clerk

OFFICE OF SPECIAL PROJECTS

Peggy DuFour	SES-1	Special Assistant to the Secretary (Special Projects)
Douglas Faulkner	GM-14	Staff Assistant to the Secretary (Intelligence) (On detail from DP)
Judith Campbell	GS-08	Secretary (Special Projects)
Terri Goldstein	GS-06	Secretary (Special Projects)

OFFICE OF SPEECHWRITING

Michael K. Jones	GM-15	Special Assistant to the Secretary (Speechwriting)
Andrew T. Gregg	GS-07	Program Assistant to the Secretary (Writer) (1 yr excepted appt NTE 12/9/90)
Charles Dowling	GS-07	Program Assistant to the Secretary (Writer) (1 yr excepted appt NTE 6/19/90)
James Evans	GS-07	Energy Program Specialist

OFFICE OF THE SPECIAL ASSISTANT TO THE SECRETARY

Rebecca Beach	SES-1	Special Assistant to the Secretary (White House Liaison)
Joe Easton	SES-1	Executive Assistant to the Secretary (Resigned effective 4-15-90)
Henry Barbour	GM-14	Staff Assistant to the Secretary (On detail to IE NTE 6/4/90)
JoeAnn Johnson	GS-12	Administrative Assistant (On detail to EM NTE 7/11/90)
Jacqueline Jones	GS-11	Staff Assistant to the Secretary
Lawanda Oates	GS-06	Secretary

OFFICE OF THE DEPUTY SECRETARY

W. Henson Moore	EX-II	Deputy Secretary of Energy
John Stone	SES-6	Executive Assistant to the Dep Secretary
Peter B. Saba	GM-15	Special Assistant to the Deputy Secretary
Susan Cornick	GM-15	Special Assistant to the Deputy Secretary
William A. Sanders, Jr.	GM-15	Staff Assistant to the Deputy Secretary
Mark Gabor	GS-13	Policy Analyst
Elizabeth B. Generro	GS-12	Staff Assistant to the Deputy Secretary
Catherine Brantley	GS-09	Secretary
Alethia Marble	GS-09	Secretary

OFFICE OF THE UNDER SECRETARY

John Tuck	EX-III	Under Secretary of Energy
Sue Walkup	GM-14	Special Assistant to the Under Secretary
Gary Palmer	LTC	Staff Assistant to the Under Secretary (On detail from DOD)
Daniel Wilken		Field Liaison to the Under Secretary (On detail from Oak Ridge National Lab)
Steve Ronshaugen		Field Liaison to the Under Secretary (On detail from Nevada)
Dan Poneman	GM-15	White House Fellow
Joyce Swanson	GS-11	Confidential Assistant to the Under Secretary (On detail from CP)
Lisa Kardell	GS-07	Staff Assistant to the Under Secretary

CONSULTANTS

Mr. Bevill. Please provide the name of each contract employee reporting directly to the Office of the Secretary, the Office of Deputy Secretary and the Office of Under Secretary. Please include their function and source of funding.

Adm. Watkins. I would like to submit for the record the names of the consultants who report directly to the Office of the Secretary. They are funded from the Departmental Administration Appropriation.

(The information follows)

CONSULTANTS TO THE OFFICE OF THE SECRETARY

Name	Function
Nancy Kober	Consultant
Thomas Griscom	Intermittent Consultant
Jane West	Consultant
Robert W. Daniel	Expert
Nancy Risque - Rohrback	Consultant
Paul Ziemer	Consultant

ESTABLISHING SINGLE APPROPRIATIONS ACCOUNT FOR CLEANUP

Mr. Bevill. In the report accompanying the FY 1988 appropriation, the Committee continued to express strong concern over the Department's repeated changes in program and appropriation structure. The report stated that "In the future, all structure changes shall be approved by the Committee prior to the submission of the annual budget."

The Department has again proposed a new appropriation "Environmental Restoration and Waste Management". Please describe how this new appropriation will improve the Department's ability to manage its programs.

Admiral Watkins. The FY 1991 budget presents, for the first time, a single, focused and unified program which relates directly to the Five-Year Plan. This budget consolidates cleanup and restoration activities previously funded within Defense programs, Nuclear Energy and Energy Research that are contained in the Five-Year Plan. Uranium enrichment activities will remain in a separate appropriations account due to the nature of the production and sales revenue environment used for these activities. This unified budget presentation should assist in ending the practice of trading off funds for environmental projects with production and programmatic activities. A separate appropriations account helps ensure that funds meant for cleanup and restoration will be spent according to priorities established among cleanup projects, and not relegated to claiming only what remains after DOE production and program needs have been satisfied.

This unified budget presentation is not intended to change or lessen Congressional oversight of the Five-Year Plan activities. Instead, we consider this consolidation will assist Congressional oversight by focusing the Five-Year Plan budget request for improved review and examination.

Mr. Bevill. Please advise why the Department considered it inappropriate to comply with the Committee with regard to this issue.

Admiral Watkins. The Department recognizes the Committee's desire that proposed restructuring be agreed to by the Committee before the budget is submitted. We try to comply with this direction as best we can. Unfortunately the timing for this structure change did not permit us to fully comply.

The Environmental Restoration and Waste Management Five-Year Plan published in August, 1989 recommended that all environmental activities covered in the Five-Year Plan be combined in as single appropriation to give this important work the visibility and flexibility necessary. The Department worked with OMB thru the Fall to get agreement on this new account and it was not finally agreed to until December 1989. Given this timing we simply did not have the time to obtain Congressional approval prior to submitting the FY 1991 budget to Congress. Our only other alternative would have been to delay the structure change until FY 1992. However, because of the importance of moving out quickly to give this program focus it could not be delayed for a year without substantial impact. Given this dilemma we briefed the Committee staff on our restructuring plans as soon as it was finalized. We realize that this does not constitute obtaining approval but given the timing was the best we could do.

Please be assured that the Department is aware of your desire to approve in advance structuring changes and will make every attempt to comply in the future. However, we hope you understand the extenuating circumstances in this particular situation and will approve the structure as submitted.

Mr. Bevill. What is the status of the sale of the Alaska Power Administration?

Admiral Watkins. The proposed legislation to authorize the sale is under review within the Administration. We expect that proposal to be ready for Congressional consideration shortly.

Mr. Bevill. Are any efforts being proposed to study the sale of the other power marketing administrations?

Admiral Watkins. The Administration proposes to sell certain power marketing rights of the Southeastern Power Administration in 1991 to existing power customers. No other sale efforts are proposed for the other three power marketing administrations at this time.

NUCLEAR WASTE FUND

Mr. Bevill. Please describe the status of the commercial nuclear waste disposal program.

Admiral Watkins. I undertook a comprehensive review of the program in 1989 and, in November 1989, announced the results of my assessment. My review centered on three areas: management restructuring for the Office of Civilian Radioactive Waste Management (OCRWM); initiatives to continue scientific investigations at the Yucca Mountain, Nevada, site; and initiatives to establish interim storage for spent fuel. The initiatives, presented in late November 1989 in a "Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program," are designed to provide the framework for a reasonable chance of success in carrying out the requirements of the Nuclear Waste Policy Act of 1982, as amended. The review has resulted in a number of actions: Dr. John W. Bartlett has been nominated by the President to be director of the Office of Civilian Radioactive Waste Management and is in the process of Senate confirmation; realistic and achievable goals and schedules have been established; organizational changes are in process which combine responsibilities, authority, and accountability so that these goals and schedules have a reasonable chance of success; resources are being directed and allocated commensurate with the responsibilities and the work to be done; and new initiatives are being undertaken to resolve problems which can impede the program, and to foster public involvement and improve two-way communication so that informed decisions are made today and in the future regarding the protection of the public health, safety and the environment. Reflecting the results of this reassessment, I have issued new program schedules that represent our realistic assessment of the duration of the

activities leading to the initiation of repository operations and the start of waste acceptance at a Monitored Retrievable Storage facility. These schedules, as discussed, incorporate consideration of externally controlled actions. I would like to submit the new program schedule for the record.

(The information follows)

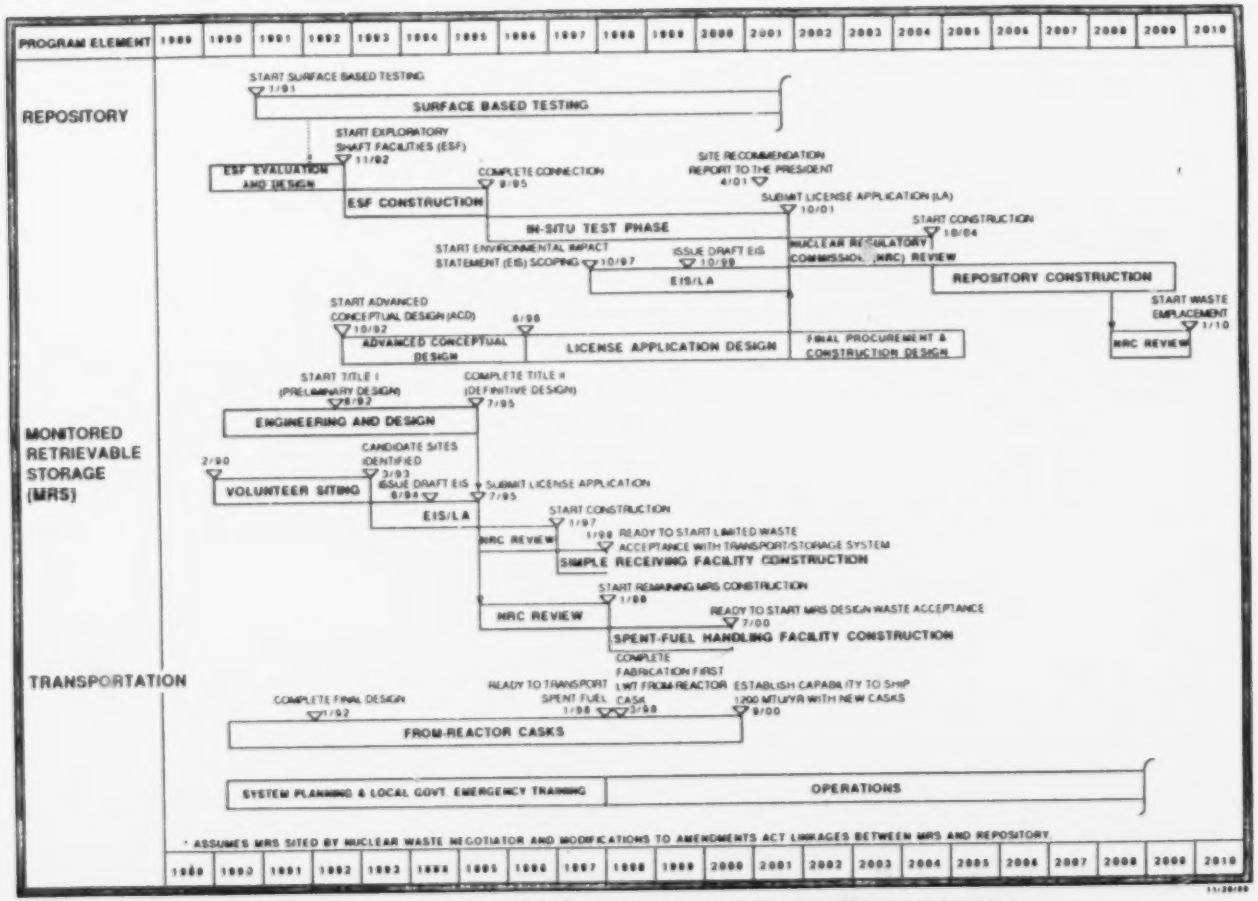
PROGRAM ELEMENT
1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
REPOSITORY
START SURFACE BASED TESTING 1/93
SURFACE BASED TESTING
START EXPLORATORY SHAFT FACILITIES (ESF) 11/92
ESF EVALUATION AND DESIGN
COMPLETE CONNECTION 9/95
ESF CONSTRUCTION
SITE RECOMMENDATION REPORT TO THE PRESIDENT 4/01
SUBMIT LICENSE APPLICATION (LA) 10/01
IN-SITU TEST PHASE
START CONSTRUCTION 10/04
START ENVIRONMENTAL IMPACT STATEMENT (EIS) SCOPING 10/97
ISSUE DRAFT EIS 10/99
NUCLEAR REGULATORY COMMISSION (NRC) REVIEW
EIS/LA
REPOSITORY CONSTRUCTION
START WASTE EMPLACEMENT 1/10
START ADVANCED CONCEPTUAL DESIGN (ACD) 10/92
6/98
ADVANCED CONCEPTUAL DESIGN
LICENSE APPLICATION DESIGN
FINAL PROCUREMENT & CONSTRUCTION DESIGN
NRC REVIEW
MONITORED RETRIEVABLE STORAGE (MRS)
START TITLE I (PRELIMINARY DESIGN) 8/92
COMPLETE TITLE II (DEFINITIVE DESIGN) 7/95
ENGINEERING AND DESIGN
2/90
VOLUNTEER SITING
CANDIDATE SITES IDENTIFIED 3/93
ISSUE DRAFT EIS 6/94
SUBMIT LICENSE APPLICATION 7/95
EIS/LA
START CONSTRUCTION 1/97
NRC REVIEW
1/98 READY TO START LIMITED WASTE ACCEPTANCE WITH TRANSPORT/STORAGE SYSTEM
SIMPLE RECEIVING FACILITY CONSTRUCTION
START REMAINING MRS CONSTRUCTION 1/00
NRC REVIEW
READY TO START MRS DESIGN WASTE ACCEPTANCE 7/00
SPENT-FUEL HANDLING FACILITY CONSTRUCTION
TRANSPORTATION
COMPLETE FABRICATION FIRST LWT FROM REACTOR
READY TO TRANSPORT SPENT FUEL 1/98
CASK 3/98
ESTABLISH CAPABILITY TO SHIP 1200 MTU/YR WITH NEW CASKS 9/00
COMPLETE FINAL DESIGN 1/92
FROM-REACTOR CASKS
SYSTEM PLANNING & LOCAL GOVT EMERGENCY TRAINING
OPERATIONS
* ASSUMES MRS SITED BY NUCLEAR WASTE NEGOTIATOR AND MODIFICATIONS TO AMENDMENTS ACT LINKAGES BETWEEN MRS AND REPOSITORY
1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

FIGURE 1. REFERENCE SCHEDULE FOR RESTRUCTURED PROGRAM *

NUCLEAR WASTE FUND

Mr. Bevill. The 1987 amendment to the Nuclear Waste Policy Act designated Yucca Mountain, Nevada, as the site for the first repository. Does any of your analysis to date indicate that this site will not be satisfactory?

Admiral Watkins. The Nuclear Waste Policy Amendments Act of 1987 did not designate Yucca Mountain, Nevada, as the site for the first repository, but rather designated the site for scientific investigation to determine its suitability or non-suitability for a repository. Our analysis to date does not indicate that this site will not be satisfactory; however, due to Nevada's refusal to issue the necessary permits, DOE has been unable to conduct the site characterization work needed to make a definitive determination.

NUCLEAR WASTE FUND

Mr. Bevill. Please describe the status of the Nuclear Waste Technology Review Board.

Admiral Watkins. The Nuclear Waste Technical Review Board (NWTRB) was established by the Nuclear Waste Policy Amendments Act of 1987. The NWTRB is an independent oversight board appointed by the President from candidates nominated by the National Academy of Sciences. Board members represent a broad range of scientific and engineering disciplines and are eminent in their fields. On January 18, 1989, the President announced his selection of eight members to serve on the Board. The Board evaluates the technical and scientific validity of the Office of Civilian Radioactive Waste Management's activities, including site characterization, waste packaging, and transportation activities. The Board is to report its findings not less than twice a year to Congress and the Secretary of Energy. After an initial meeting in March 1989, the NWTRB established panels in the following five areas: Environmental and Public Health, Structural Geology and Geoengineering, Hydrogeology and Geochemistry, Containers and Transportation, and Risk and Performance Analysis. We understand that the Board's first report is to be issued on March 22, 1990.

NUCLEAR WASTE FUND

Mr. Bevill. Please describe the status of the Office of the Nuclear Waste Negotiator.

Admiral Watkins. The Nuclear Waste Policy Amendments Act of 1987 provides for a Nuclear Waste Negotiator to be appointed by the President and confirmed by the Senate. The Negotiator is to seek a State or Indian Tribe willing to host a repository or a Monitored Retrievable Storage facility at a technically qualified site on reasonable terms. The Negotiator would seek to reach a proposed agreement specifying the terms and conditions under which the State or Indian Tribe would host such a facility. Any proposed agreements would have to be approved and enacted into law by the Congress. Several candidates for the position of Negotiator have been considered; however, no nomination has yet been made by the President. The Department has been working with the White House on the appointment of the Nuclear Waste Negotiator.

NUCLEAR WASTE FUND

Mr. Bevill. Please describe the status of your review of a possible site for a Monitored Retrievable Storage (MRS) location.

Admiral Watkins. While the Nuclear Waste Policy Amendments Act of 1987 authorized the Department to conduct a survey and evaluation of potentially acceptable sites subsequent to submittal of the MRS Review Commission's report to the Congress, the Department is pursuing the second path authorized by that Act, that of seeking a volunteer host. In this regard, the Department is prepared to support the Nuclear Waste Negotiator when appointed.. The Department also is studying other alternatives that will support efforts to find a volunteer host.

NUCLEAR WASTE FUND

Mr. Bevill. Please describe the process used in developing the budget for the proposed grants to the State and local governments.

Admiral Watkins. In developing the FY 1991 budget for financial assistance to the State of Nevada and the affected units of local government, the Department reviewed the budget requirements they provided, the level of funding Congress provided for financial assistance in FY 1990, and the status of the repository program. The recommended budget level for FY 1991 of $5 million for the State of Nevada and $5 million for the affected units of local government is based on the Department's estimate of required oversight activities.

FORRESTAL BUILDING

Mr. Bevill. The Committee has been advised that the effort to replace the roof at the Forrestal Building has resulted in considerable air pollution in the building. Please advise the Committee of your efforts to alleviate this problem.

Adm. Watkins. The Forrestal Roof Replacement Project is a General Services Administration (GSA) initiative. In order to minimize the asphalt fume problems, GSA has modified their contract to include the blockage of the fresh air intake louvres during the hours when the asphalt application is taking place. Indoor air samples are being collected from affected locations and analyzed to assure an acceptable comfort level. To date the test results have been well below established criteria for asphalt fume levels. These initiatives, in conjunction with DOE operations and maintenance schedules, will be in place for the duration of the project.

FAST FLUX TEST FACILITY

Mr. Bevill. Please describe the relative advantages of operating EBR-II or FFTF in support of the Liquid Metal Reactor program.

Admiral Watkins. The Liquid Metal Reactor program is focused on the Integral Fast Reactor (IFR) concept which has been under development at the Argonne National Laboratory (ANL) since 1985. The EBR-II reactor and the associated facilities at the ANL-West site, in Idaho, provide the necessary capabilities to complete a recycle feasibility demonstration by 1993.

The FFTF complex could also be used to demonstrate the IFR concept. However, it would require $30-40 million in capital cost and at least $60 million more per year to operate the FFTF versus the EBR-II. In addition, there would be a 3 to 4 year delay to establish capabilities at the FFTF complex equivalent to those at ANL-West and a cost increase of $630 million to $740 million for completion of the demonstration. Consequently, the EBR-II and the associated facilities at ANL-West provide the most cost-effective means of developing this technology.

FAST FLUX TEST FACILITY (FFTF)

Mr. Bevill. Please describe the possible use of FFTF as nuclear waste burner and the potential savings in repository costs if this application is successful.

Admiral Watkins. The Department has examined this alternative and concluded that this is not a practical use for the FFTF. The bulk of defense wastes that would be suitable for burnup in a reactor such as FFTF will not become available until after 1997 and the quantity expected at that time will be quite small. We cannot justify the costs of continuing to operate the FFTF into the late 1990s, at a cost of over $100 million per year, based on the possibility that this program may be undertaken.

The Department is currently developing and plans to demonstrate much of the technology needed for actinide recycle at the EBR-II complex. As part of this national program, technical, institutional and economic issues will be more precisely defined. We believe that this program can be more cost-effectively executed at the EBR-II complex.

FAST FLUX TEST FACILITY (FFTF)

Mr. Bevill. Please describe Japan's reaction to your decision to terminate the 5-year Fusion irradiator test program in FFTF.

Admiral Watkins. Our proposed shutdown of the FFTF is not intended to terminate the cooperative Fusion Irradiation Test Program. While the FFTF would no longer be available to conduct testing associated with this program, we plan to use other facilities owned and operated by the Department to continue the program.

I have received a letter from the Japan Atomic Energy Research Institution which expresses concern over the proposed shutdown of the FFTF and its implications for further collaborative work between Japan and the United States. I believe their concerns are somewhat premature and fail to consider use of other irradiation test facilities, such as the EBR-II, to continue the program.

We will continue to make every reasonable effort to reach agreement with the Japanese to achieve the technical objectives of the cooperative fusion program, including sending a delegation from the Department to discuss with the Japanese the use of the EBR-II reactor complex.

FAST FLUX TEST FACILITY (FFTF)

Mr. Bevill. How do you react to the possible loss of Japan as a partner in other energy initiatives because of your decision?

Admiral Watkins. I do not believe that we will lose Japan as a partner because of our decision to shutdown the FFTF. The Department intends to make every reasonable effort to reach agreement with the Japanese to achieve the technical objectives of the cooperative fusion program. As mentioned previously, a delegation from the Department will meet with the Japanese this month to discuss the utilization of the EBR-II reactor complex for the fusion program. I am convinced we can make the case that we are reliable partners in this endeavor and that the economic "facts-of-life" required us to make this change in the program.

FAST FLUX TEST FACILITY (FFTF)

Mr. Bevill. Please describe what other U.S. facilities that might be used to conduct the U.S./Japanese fusion research that was planned for FFTF.

Admiral Watkins. The complex of facilities at the Argonne National Laboratory-West can be used to conduct the fusion test program. Scoping studies and meetings have been held which indicate that fusion materials, fusion tritium-producing experiments, and open-core materials testing can be done in the EBR-II. The support facilities at the ANL-W site (notably the Hot Fuels Examination Facility) can be used to provide post-irradiation examination services.

FAST FLUX TEST FACILITY (FFTF)

Mr. Bevill. The committee is aware of the expanding use of medical and industrial isotopes. Why is it not possible to expand the use of FFTF as an isotope producer?

Admiral Watkins. Existing Department reactors or accelerators have produced the radioisotopes which have been sold by the Department to date. There has been no significant current market for radioisotopes which can only be produced in a fast reactor environment. Although we have demonstrated that the FFTF can effectively produce certain isotopes, such as Gadolinium-153, we believe that existing Department reactors and accelerators can meet radioisotope market needs for the foreseeable future. To produce a wide variety of isotopes effectively at FFTF, we would require capital expenditures of up to $25 million.

ENVIRONMENTAL CLEANUP

Mr. Bevill. Please describe the five-year plan to clean up DOE facilities.

Admiral Watkins. The Environmental Restoration and Waste Management Five-Year Plan is the planning basis for all activities connected with the management, cleanup, and disposal of the waste materials resulting from DOE's past and present nuclear operations. It consolidates, for the first time, the waste management and cleanup activities formerly carried out under the major DOE program areas of Defense Programs, Nuclear Energy, and Energy Research and is the cornerstone of the Department's long-term environmental restoration and waste management strategy to reach the Department's goal to clean up all of its sites and facilities within 30 years. The first Five-Year Plan was published in August 1989, and covered the planning period FY 1991 through FY 1995. The first annual update of the Plan, currently in preparation, covers the planning period FY 1992 through FY 1996.

Environmental Restoration, i.e., cleanup, of DOE facilities is a major planning category. It is concerned with the assessment and cleanup of facilities and sites that are no longer a part of active operations but are contaminated with various quantities of transuranic, low level, hazardous, or mixed radioactive and hazardous waste materials. Carried out primarily in accordance with the provisions of RCRA, CERCLA, the AEA, and various State laws, Environmental Restoration consist of two types of activities: Remedial Actions and Decontamination and Decommissioning (D&D). Remedial Actions are concerned with all aspects of the assessment and cleanup of inactive sites. D&D is concerned primarily with the safe caretaking of surplus nuclear facilities and either their decontamination for reuse or their dismantling and

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removal. The Plan describes a program for carrying out cleanup on a installation-by-installation basis, assigns priorities to such activities, sets forth milestones connected with accomplishing work, and provides projections of funding for carrying out the activities associated with each priority level.

Mr. Bevill. Please describe your priority assignments for cleanup.

Admiral Watkins. Cleanup activities described in the Environmental Restoration and Waste Management Five-Year Plan are organized into four priority categories that reflect discrete circumstances connected with a specific activity.

Priority 1 activities are concerned with protection against near-term potential health risks, containment of offsite near-term spread contamination, preclosure surveillance and maintenance.

Priority 2 activities are subject to the provisions of compliance agreements that are either negotiated and in force or that are expected to be negotiated and in force.

Priority 3 activities are concerned with compliance with all regulatory requirements other than negotiated agreements.

Priority 4 activities are all other activities not directly related to near-term or compliance requirements.

Mr. Bevill. Please describe the estimate of the total cost to clean up the environmental issues at the Department.

Admiral Watkins. The Department has not performed an overall analysis to determine a total cost of cleaning up its entire nuclear complex. For reasons give below, the Department does not believe it appropriate or possible

to do so at this time, and any estimate of a hypothetical total cost would likely be misleading. Instead, I initiated the Environmental Restoration and Waste Management Five-Year Plan with a five-year planning horizon and a requirement to update this Plan annually.

Although DOE attempts to develop accurate cost estimates in order to request adequate funds for carrying out cleanup activities, areas of considerable uncertainty exist with regard to such costs. Costs are strongly dependent on the requirements, extent, and nature of individual cleanup actions; and estimates of costs reflect the degree to which the aggregate of engineering and remedial work connected with specific sites progresses, becoming more detailed and precise as work proceeds. The cleanup of DOE's installations is in a comparatively early stage of implementation. Although many cleanup actions are underway, the major fraction of current specifications concerning the nature, extent, amount of contamination, required technology, and specific cleanup action are based, generally, on data derived from ongoing site assessments. Consequently, most current cleanup cost estimates should be considered to be projections based on what has been learned from, as yet, incomplete characterization of known sites. Such projections reflect only partial technical data, assumptions concerning significant cleanup needs, and possible methods of accomplishing cleanup tasks.

Based on the results of ongoing site assessment and cleanup work, DOE continually updates its estimates of program cost. Such cost updates are to be reflected in each annual revision of the Environmental Restoration and Waste Management Five-Year Plan.

SAVANNAH RIVER CAPABILITY

Mr. Myers. Do you believe that the existing Savannah River capability will sustain the U.S. demand for tritium until new production capacity is completed?

Admiral Watkins. There are no known life-limiting conditions that would force the permanent shutdown of the Savannah River site reactors. However, these reactors are over 40 years old and have not been maintained adequately in the past. With improved maintenance practices which are being initiated, we are optimistic that these reactors will be able to operate until new capacity is available.

TRITIUM PRODUCTION ALTERNATIVES

Mr. Myers. In view of the complications at Savannah River, has the Department pursued further any of the identified alternatives for tritium production?

Admiral Watkins. No, there are no viable near-term alternatives for the production of tritium other than the Savannah River reactors.

Mr. Myers. What is your assessment of the capability of the FFTF to serve as replacement capacity for the Savannah River reactors?

Admiral Watkins. The study which led to the decision to build two New Production Reactors considered the FFTF and other options. The FFTF could produce only a fraction of the amount of tritium needed and, therefore, could not serve as a replacement capacity for the Savannah River reactors. In addition, major investments at FFTF would have been required to develop and procure a new fuel/target system and to construct all the reprocessing and fabrication facilities required for the complete mission.

NEW PRODUCTION REACTORS

Mr. Myers. Does the fiscal 1991 budget request for the New Production Reactors program ($363 million) keep both technologies and sites on schedule?

Admiral Watkins. Yes, the fiscal year 1991 request of $363 million will allow the Department to continue with those actions necessary to maintain our current and projected schedules for bringing new production reactor capacity on line within 10 years from the start of design. In November 1989, contracts were awarded for conceptual designs of both the heavy water reactor and the modular high temperature gas cooled reactor. Currently, we are ahead of our schedules for conceptual design. This is an ambitious program and your continued support is necessary for us to continue those activities necessary to meet our schedules.

Mr. Myers. Do you continue to support the multi-site, multi-technology strategy for this program?

Admiral Watkins. The Department's preferred strategy of constructing two new reactor plants of different technologies at two sites is a sound one. I am still committed to this strategy of duality which will provide a high degree of assurance of sufficient tritium for national security needs.

Mr. Myers. How is the Department coordinating its efforts in the commercial and defense applications of the modular high-temperature gas-cooled reactor technology?

Admiral Watkins. There are unique as well as common technical development efforts for the commercial and new production reactor modular high-temperature gas-cooled reactors. Because of the expeditious schedule of this program and its special mission, all unique and schedule-driven common technology development will be conducted by the New Production Reactors Program. To avoid any duplication and to ensure technical completeness and consistency, development activities between the commercial and defense programs are closely coordinated, including a formal Memorandum of Agreement between the Office of New Production Reactors and the Office of Nuclear Energy.

SPECIAL ISOTOPE SEPARATION FACILITY

Mr. Myers. Please explain the decision not to build the Special Isotope Separation (SIS) facility. What specifically has changed which compelled the Department to reverse its position on this project?

Admiral Watkins. Current budget constraints have forced the Department to reevaluate its decision to proceed with the construction of the Special Isotope Separation (SIS) facility in Idaho. Accordingly, the Department has not requested construction funding in FY 1991. This decision is based on a reassessment of the Department's priorities in order to conform to the budget constraints imposed by the FY 1991 and anticipated future budgets.

The SIS facility would have provided the Department with an additional source of weapon-grade plutonium as a contingency to meet any future identified needs for this material. In order to preserve a viable option for future deployment of this contingency, the Department proposes to complete the development of the SIS technology at the Lawrence Livermore National Laboratory in California. By bringing the research and development program in an orderly and logical conclusion as proposed, the Department will be positioned to deploy promptly this capability should that need arise in the future.

SPECIAL ISOTOPE SEPARATION DECISION

Mr. Myers. Does the decision not to build the SIS assume the construction or rehabilitation of plutonium production, recovery, or processing facilities elsewhere? If so, please elaborate.

Admiral Watkins. The Special Isotope Separation (SIS) facility would have provided an additional source of material to meet potential plutonium needs arising from increases in demand, disruption in the ongoing recovery of existing material, and as necessary, to maintain a desired level of reserves. It would also have provided diverse mission capability in the long term. The proposed budget, however, implements an orderly closeout of the SIS program due to higher funding priorities within the defense materials production complex.

While the decision not to construct the SIS facility at this time was based on severe budget constraints, the Department of Energy must consider both current and future production capability based on its projections for demands for such materials. Implementation of proposed production initiatives such as the New Production Reactor strategy and the Plutonium Recovery Modification Project (PRMP) at Rocky Flats, as well as the successful restart of three production reactors at the Savannah River Plant.

Specifically, with respect to plutonium, the recovery of plutonium from the residue backlog and weapons returns, as well as the processing of currently generated residues, is key to meeting successfully the plutonium supply requirements for modernizing the nuclear weapons stockpile under currently

specified Department of Defense production requirements. Currently, processing of these materials is heavily dependent upon aging facilities of questioned reliability and environmental conformance. The proposed PRMP at Rocky Flats will provide a reliable capability for processing plutonium scrap and returns, permit operational transition should the Rocky Flats capability be relocated, and provide onsite decontamination capability for eventual phaseout of the Rocky Flats site.

SIS AVLIS APPLICATION

Mr. Myers. Does the R&D work done on the SIS have any application to the AVLIS technology development and deployment?

Admiral Watkins. The Special Isotope Separation (SIS) project would have deployed a plutonium isotope separation capability for purification of Department of Energy (DOE) owned feedstocks of fuel-grade plutonium to weapon-grade assay. This would have been accomplished using the principles of selective photoionization and electrostatic separation of vaporized plutonium isotopes. This process, known as Atomic Vapor Laser Isotope Separation (AVLIS), is currently under final development and demonstration at the Lawrence Livermore National Laboratory (LLNL) in California, along with state-of-the-art balance of plant processes and equipment.

A significant portion of the SIS R&D work is directly applicable to the ongoing uranium-AVLIS (U-AVLIS) program technology development and deployment also being performed at the LLNL. The SIS and U-AVLIS programs, though independent, have to date each contributed $30 million per year to the roughly $60 million per year in ongoing generic AVLIS support facility and technology development costs necessary to conduct AVLIS programs. The primary example is the development and generation of process light to both programs from the same laser facility. Also, since the isotopic separation physics is similar for the two programs, much of the increased understanding of physical processes gained by SIS is applicable to U-AVLIS. SIS will no longer share in defraying these $60 million in basic AVLIS costs beyond FY 1991.

Aside from maintaining the SIS deployment option and contributing to the U-AVLIS program, the SIS technology has numerous potential applications. The National Academy of Sciences (NAS) has been requested to conduct a review of alternate applications of the SIS technology in the areas such as waste minimization and the isotopic purification of other elements. Completing and documenting the technology development at LLNL will facilitate the completion and possible implementation of the NAS study as well as facilitating the transfer of this technology to the private sector as appropriate.

SUPERCONDUCTING SUPER COLLIDER

Mr. Myers. What would be the effect of building a less powerful machine within the DOE's original cost estimates?

Admiral Watkins. We had the High Energy Physics Advisory Panel form a special subpanel to consider the impact of various SSC energy levels. The HEPAP report strongly recommended retaining the 20 TeV energy on the basis that any lower energy would compromise our ability to elucidate some of the most important physics. I have accepted that recommendation.

Mr. Myers. What is the status of the Department's effort to develop international collaboration on the SSC?

Admiral Watkins. The International Plan has been reviewed by an interagency group and is now being finalized. This plan, once approved, will provide the framework within which the DOE will conduct negotiations and the negotiating strategies for the various countries. This plan has not been made public because of the sensitive negotiation material it contains. The Department also is using official channels to keep government officials abroad informed on progress of the program.

Meanwhile, the SSC Laboratory has been actively and systematically keeping the scientific community in other countries informed. The SSC Laboratory has been seeking international participation in conferences, workshops, symposia, and advisory committees, etc., so that foreign scientists are a part of the SSC endeavor and can advise their governments on the benefits of collaborating on the SSC and the excitement and promise of the project.

We recognize the need to apprise Congress of our international cost-sharing strategy, but have postponed doing so pending our review of the preliminary site-specific design and cost estimate. We intend to brief Congress in the near future on the International Plan. We also recognize the need to notify Congress prior to entering into any final arrangements on foreign contributions.

Mr. Myers. Please explain any existing federal law or regulation which the DOE has identified that will impact on foreign participation in the SSC project?

Admiral Watkins. Under the Department of Energy's organic legislation, the Secretary of Energy has broad authority to participate in international activity and to accept the financial participation of non-Federal sources. This authority comes from powers transferred to the Secretary of Energy from its predecessor agencies, at the creation of the Department of Energy. I will be pleased to provide more detailed information for the record.

(The information follows)

Section 103 of the Energy Reorganization Act of 1974 (42 U.S.C. 5801, et seq. Pub. L. No. 93-438, as amended), makes it a Secretarial responsibility to participate in and support cooperative research and development projects which may involve contributions, by public or private persons or agencies, of financial or other resources to the performance of work (Section 103(5)) and to encourage and participate in international cooperation with respect to energy and related environmental research and development (Section 103(10)). Section 107(a) gives the Secretary authority to make arrangements (including contracts, agreements, and loans) for the conduct of research and development activities with private or public institutions or persons, including participation in joint or cooperative projects of a research, developmental, or experimental nature. And Section 107(f) authorizes the Secretary to accept gifts and bequests of property, real and personal, for the purpose of aiding or facilitating the work of the Department.

Under Section 102(10) of the Department of Energy Organization Act (42 U.S.C. 7101 et seq. Pub. L. No. 95-91), one of Congress' purposes in establishing the Department of Energy was to implement policies regarding international energy issues that have a direct impact on research, development, utilization, supply, and conservation of energy and the undertaking of activities to integrate domestic and foreign policy relating to energy. Under this Act, the Secretary has authority to enter into various types of contractual instruments with public agencies and private organizations and persons (Section 646(a)).

In addition to the general authorities described above, the Secretary is empowered pursuant to Section 301 of the Energy and Water Development Appropriations Act, 1990 (Pub. L. No. 101-101) to, among other matters, "accept lands, buildings, equipment, and other contributions from public and private sources and to prosecute projects in cooperation with other agencies, Federal, State, private, or foreign."

The Energy and Water Development Appropriations Act, 1990 (Pub. L. No. 101-101) requires a report on foreign participation in the SSC prior to spending appropriated funds to finalize any foreign participation agreements. Congress will use the report to be able to make a decision on how much and what type of foreign participation is appropriate.

Procurements by DOE are subject to Public Law 96-369, the Competition in Contracting Act of 1984 (CICA) and other laws, including the Buy American Act.

However, the literal terms of CICA do not apply to procurements carried out by Management and Operating (M&O) contractors, such as Universities Research Association, Incorporated (URA), the M&O contractor for the SSC Laboratory. Each contract between DOE and the M&O contractor provides for the applicable procurement requirements. Under these contracts, contractors are required to follow competitive principles and procedures in their procurement actions, as set out in DOE acquisition regulations and various General Accounting Office decisions. These regulations and decisions are collectively known as the "Federal Norm" and set out the principles of the Federal procurement process by which these M&O contractors are guided in their procurement activities. The "Federal Norm" does not however require these contractors to follow all of the detailed procedures of the Federal procurement process, so long as they utilize general fairness, open competition, etc., in their subcontracting activities.

Should the Secretary of Energy ever wish to restrict foreign competition in appropriate circumstances, he can invoke exemption 7 to CICA, which allows restriction of competition in the public interest.

The Buy American Act requires that only domestic end products be acquired for public use unless the lowest acceptable domestic offer exceeds the lowest acceptable foreign offer, inclusive of duty, by:

(1) more than 6 percent, if the domestic offer is from a large business that is not a labor surplus area concern; or
(2) more than 12 percent if the domestic offer is from a small business concern or any labor surplus area.

The Buy American Act makes an exception to acquiring domestic end products if the Secretary of Energy should determine that domestic preference would be inconsistent with the public interest, i.e., that procurement of foreign-supplied end products could be preferred over domestic end products. The Buy American Act does not allow the Secretary of Energy to make a determination in favor of domestic vendors over foreign vendors. That is, the Secretary can prefer foreign end-products over domestic end-products but not vice versa.

SSC programmatic activities will comply with National Security Decision Directive 189 of September 21, 1985 (NSDD-189) which discusses treatment of basic research information.

The statute governing the control of scientific and technical information is the Export Administration Act of 1979, as amended in 1981 and 1985, and as implemented by the U.S. Department of Commerce as the controlling agency for

the Federal Government. The Department of Commerce implements the export control of unclassified technology through the Export Administration Regulations which are found in the Code of Federal Regulations (15 CFR, 768-799).

Executive Order 12591 of April 10, 1987, Facilitating Access to Science and Technology, requires agencies negotiating international R&D agreements to consult with the United States Trade Representative to insure that the U.S. benefits fully from the science and technology abroad. In particular, agencies are to ensure that the country offers comparable R&D and licensing opportunities and properly protects U.S. intellectual property rights and national security information.

DOE also has statutorily mandated functions regarding information and data dissemination as well as technology transfer to industry. These functions were set forth in legislation specific to DOE and in legislation applicable to DOE's predecessor agencies, the Energy Research and Development Administration and the Atomic Energy Commission. From these authorities, as well as the Freedom of Information Act, that DOE has positive obligations of technology transfer and dissemination of technical information.

The SSC Laboratory will follow the visit and assignment procedures prescribed in DOE Order 1240.2A, Unclassified Visits and Assignments by Foreign Nationals, of January 10, 1989.

Determination of the eligibility of components for duty-free importation is the responsibility of the Customs Service of the Treasury Department and the International Trade Administration of the Department of Commerce. The current structure for tariffs, which is based on an international treaty as well as U.S. laws and regulations, did not envision as ambitious a scientific instrument as the SSC and current regulations may be an impediment to securing major international contributions to the SSC program.

MAGNETIC FUSION ENERGY

Mr. Myers. Is it correct that the fiscal 1991 budget requests for the fusion programs do not assume a new policy?

Admiral Watkins. Yes, that is correct. The FY 1991 budget was drafted with the understanding that a high-level fusion policy review will be completed by the end of September 1990. With this policy review time schedule in mind, the FY 1991 budget is structured, as much as possible, to maintain options, continue scientific progress and international cooperation and avoid damage to the U.S. fusion research infrastructure.

Mr. Myers. Will the Subcommittee receive budget reallocation requests from the Department to implement the new fusion policy? If so, when?

Admiral Watkins. If the Department's response to the Fusion Policy Advisory Committee (FPAC) recommendations requires the reallocation of funds, the Congressional Appropriations and Authorization Committees will be notified. If the actions the Department takes in response to FPAC recommendations do not require a reallocation, the Congressional Committees and interested Members would still be informed of the results of the review.

I have asked the FPAC Chairman, Dr. Stever, to supply me with an interim report in July 1990. Some actions may be initiated on the basis of this interim report. The Advisory Committee's final report will be finished by September 30, 1990. You can expect the Department to act promptly in response to this final report.

ESTABLISHING SINGLE APPROPRIATIONS ACCOUNT FOR CLEANUP

Mr. Myers. What is the rationale for the proposal to restructure the budget and appropriations accounts for the Department's environmental restoration and waste management (EM) activities?

Admiral Watkins. The FY 1991 budget presents, for the first time, a single, focused and unified program which relates directly to the Five-Year Plan. This budget consolidates cleanup and restoration activities previously funded within Defense programs, Nuclear Energy and Energy Research that are contained in the Five-Year Plan. Uranium enrichment activities will remain in a separate appropriations account due to the nature of the production and sales revenue environment used for these activities. This unified budget presentation should assist in ending the practice of trading off funds for environmental projects with production and programmatic activities. A separate appropriations account helps ensure that funds meant for cleanup and restoration will be spent according to priorities established among cleanup projects, and not relegated to claiming only what remains after DOE production and program needs have been satisfied.

This unified budget presentation is not intended to change or lessen Congressional oversight of the Five-Year Plan activities. Instead, we consider this consolidation will assist Congressional oversight by focusing the Five-Year Plan budget request for improved review and examination.

TOTAL FY 1991 REQUEST FOR CLEANUP

Mr. Myers. What is the total amount requested for the environmental restoration and waste management activities and how does that compare to the fiscal 1990 appropriated leve?

Admiral Watkins. The FY 1991 budget request of $2.791 billion is 26 percent, or $573 million, over the FY 1990 level. This budget continues the rapid acceleration of the cleanup of DOE facilities started by President Bush's allocation of an additional $300 million to the FY 1990 budget request and the Congress's action to appropriate on additional $357 million for FY 1990.

FIVE-YEAR PLAN R&D

Mr. Myers. Please explain the research component of the Office of Environmental Restoration and Waste Management (EM) activities and the corresponding budget requests for fiscal year 1991.

Admiral Watkins. The primary mission of the Technology Development program is to establish and maintain an aggressive national program for applied research, development, demonstration, testing, and evaluation (RDDT&E). This mission supports the Department of Energy's (DOE's) 30-year compliance and cleanup goal by establishing the management process for funding technologies at their various stages of development and deployment for better, faster, and more cost-effective interim and permanent solutions to environmental problems; conducting an innovative, aggressive technologies development program for waste management, waste minimization, waste treatment, storage, and disposal; developing more effective remediation technology for restoration of contaminated sites and facilities; developing technologies to reduce occupational and public exposure; establishing a coordinated education program involving universities, DOE national laboratories, and industry to train the people needed to address DOE's Environmental Restoration and Waste Management problems; and promoting technology transfer and outreach among the Department, private sector, and other agencies.

Through the Technology Development program DOE will accelerate needed developments on high-priority problems, i.e., those requiring better, more permanent solutions. Emphasis will be placed on improved or new technology for characterization of sites to determine the magnitude and extent of contamination spread and its physical and chemical nature. Industrial, university and DOE laboratory methods will be studied for the most capable and

effective restoration and treatment techniques which can be applied to a broad range of DOE site problem. Establishing a separate technology development program provides the focus of scientific talent to effectively screen available and evolving technologies and provide demonstrated and proven methods for use.

The budget request for Technology Development for FY 1991 is $206 million a 12 percent increase over FY 1990.

CLEANUP R&D AT UNIVERSITIES

Mr. Myers. Do the EM research activities include university-based research? If so, please explain and indicate the requested funding levels for fiscal 1991.

Admiral Watkins. The Office of Technology Development will conduct research, development, demonstration, testing and evaluation in support of the Environmental Restoration and Waste Management (EM) operations. Although many of these activities will be conducted primarily at the Department's national laboratories, efforts have been initiated to expand the use of the valuable research capabilities at universities directed toward the EM mission requirements. Pilot centers for university partnerships have been established in South Carolina and New Mexico with collaborative research activities for teaching/ research efforts related to curriculum development which are estimated to be $3 million in FY 1991. Other university-based research activities supporting EM are expected to be competitively procured following issuance of requests for proposals this spring. Following competition, projects which are awarded to the private sector and universities for FY 1991 could be as much as $20 million.

Mr. Myers. Please explain the relationship, both in organizational and budget terms, between the new office of Environmental Restoration and Waste Management and the existing Office of Environment, Safety and Health?

Admiral Watkins. The Office of Environmental Restoration and Waste Management (EM) is a line office which is established to consolidate environmental cleanup, compliance and waste management activities identified in the Five-Year Plan. EM provides centralized management and planning and focused headquarters' control and validation of cost, schedule and priority of environmental restoration and waste management projects at DOE facilities not actively used for production. EM also administers an aggressive environmental restoration and waste management applied research and technology development program.

The Office of the Assistant Secretary for Environment, Safety and Health (EH) directs its oversight to the implementation of environmental, safety and health policies. EH develops and coordinates Department of Energy policy and guidance, and conducts assessments to assure compliance with applicable laws related to environmental protection, radiation safety, worker safety, and those aspects of public health and safety that deal with epidemiology and radiological protection.

EH is also responsible for inspecting and assessing the effectiveness of the Department's safeguards and security

policies, programs, and implementation in the field, and for the safety certification of packages for shipment of DOE radioactive materials.

EH's role is that of an independent overseer of compliance with environment, safety and health requirements. EH establishes DOE health and safety policy. EH oversees EM's implementation of its programs.

In terms of budget, EM is responsible for the development and overall execution of those DOE initiatives included in the Five-Year Plan. The EH budget, used to fund its oversight functions, is separate.

FAST FLUX TEST FACILITY (FFTF)

Mr. Myers. Does the fiscal 1991 budget request assume the closure of the FFTF? If so, please indicate the funding level which would be necessary to continue existing programs at the facility in fiscal 1991.

Admiral Watkins. The fiscal year 1991 budget request of $46.6 million assumes the start of FFTF shutdown on April 1, 1990, and continuing required shutdown activities during 1991. Funding of at least $100 million would be required in fiscal year 1991 to continue FFTF operations and existing programs.

GOVERNMENT CONTRACTORS

Mr. Myers. The Department is making a very important review of its relationship with the contractors that operate many DOE facilities. Please outline pending proposals to change this relationship.

Admiral Watkins. We are taking a number of far reaching steps to enhance the long-standing relationship that the DOE has had with its contractors that manage and operate its plants and laboratories operations. These steps are designed to improve contractor performance, increase accountability of the contractor for the work it is responsible for, and to use the forces of the competitive marketplace to secure for these operations the best management talent that American industry can provide.

As you know, the Department is completing implementation of changes which I directed regarding use of award fee in order to enhance the accountability of the management and operating contracts that operate our facilities. The changes we have published require that an evaluation of our contractors be made every six months in accordance with an established Performance Evaluation Plan, and that these plans base at least 51 percent of the award fee on environment, safety and health functions for defense production facilities with commensurately increased percentages for environment, safety and health for other facilities. Our changes also provide that, if the contractor's performance is considered unacceptable in any area of performance specified in the Performance Evaluation Plan, the contractor's overall performance may be

considered unacceptable and the entire award fee for the evaluation period withheld.

Realistic contractor self-assessments are now required and shall become an integral part of the evaluation of a contractor's management effort and its commitment to achieving standards of excellence.

As you may also know, on January 26, 1990, the Department published a Notice of Proposed Rulemaking in the Federal Register (55 FR 2796) which is intended to clarify the responsibilities of its for profit-fee bearing management and operating contractors. The DOE's objective in proposing the new rule is to emphasize the importance it places on excellent performance by its contractors, particularly in the areas of environment, health and safety, in operating DOE facilities.

This rulemaking specifies conditions under which the M&O contractors assume the risk for certain avoidable costs. The proposed rulemaking affects only those M&O contractors that receive a profit under their contracts with DOE. I would like to insert for the record the proposed nonreimbursable costs.

(the information follows)

PROPOSED NONREIMBURSABLE COSTS

- Costs and expenses resulting from damage to government property solely as a result of ordinary contractor negligence in extraordinary, nonroutine circumstances.
- Losses of government property resulting from theft, embezzlement or unauthorized use.
- Fines, penalties, judgments and other litigation costs arising from contractor noncompliance with environmental laws, within the contractor's ability to have complied.
- Judgments and other litigation costs stemming from common-law contractor negligence or misconduct giving rise to simple tort liability to third parties.
- Civil and criminal penalties assessed pursuant to the Price-Anderson Amendments Act of 1988, and costs of litigation involving such penalties. M&O contractors would continue to be indemnified against public liability for a nuclear incident as specified under Price-Anderson. (Under the 1988 Act, the Secretary of Energy is authorized to impose civil fines on certain government contractors for violations of applicable DOE nuclear safety rules, regulations and orders.)
- Any other costs that stem from the willful misconduct or lack of good faith of an M&O contractor supervisory or management employee.
- Costs of insurance for nonreimbursable avoidable costs.

Under the proposed rulemaking, DOE would continue to indemnify M&O contractors against non-nuclear risks for actions within the scope of work of the contract.

In view of the risks and uncertainties unique to these government facilities, a ceiling would be placed on the liability of the contractor for avoidable costs incurred under this proposal. This ceiling would be equal to the maximum potentially available award fee for the six month evaluation period.

The contractor would be required to provide a guarantee that it would satisfy any potential future liability discovered after the award fee period or after the contract is terminated.

DIFFERENTIATION AMONG CONTRACTORS

Mr. Myers. In implementing new contractual terms or regulations affecting Government contractors, will the DOE differentiate in any way between those contractors which operate for profit and those which are not-for-profit?

Admiral Watkins. The Notice of Proposed Rulemaking (NOPR) published on January 26, 1990 applies only to profit making M&O contractors. We did, however, solicit comments from the Public regarding DOE's relationship with its nonprofit M&O contractors. The NOPR contains provisions designed to increase accountability and excellence from our contractors in all performance areas, but with emphasis on environment, safety and health.

When this rulemaking becomes final, DOE proposed to include whatever provisions ultimately are adopted in the final rule in new or extended contracts and in each current M&O contract as the annual fee is negotiated.

NUCLEAR WASTE FUND

Mr. Myers. Is the fiscal 1991 budget request of $292.8 million for the Nuclear Waste Fund realistic in view of the substantial administrative, legislative, and legal hurdles facing the Department on the Yucca Mountain project?

Admiral Watkins. Yes, the fiscal 1991 budget request is realistic. The current hurdles facing Yucca Mountain have prevented initiation of any new surface-disturbing activities but have not stopped the very significant ongoing work involving: seismic, hydrologic and meterologic monitoring; laboratory sample analysis; development of predictive models; and performance assessment activities. Litigation is underway to resolve the hurdles to surface disturbing work. The FY 1991 request is based on DOE's restructured program presented in the November 1989 report to the Congress. At Yucca Mountain, emphasis will be placed on: completion of alternative design studies and Title II design for the exploratory shaft; providing grant funds for oversight activities to affected units of local governments and to the State of Nevada; and on developing and maintaining a Quality Assurance Program accepted by the Nuclear Regulatory Commission. The Monitored Retrievable Storage program (MRS) will initiate generic conceptual design, implement the overall MRS strategy, and initiate a grant program for feasibility studies. The Transportation program will complete design reviews on legal weight truck and rail/barge casks and continue to conduct engineering, drop and design verification tests and cooperative agreements with national and regional groups.

NUCLEAR WASTE FUND

Mr. Myers. Last year the problems surrounding work at Yucca Mountain led OMB to recommend a reprogramming from the Nuclear Waste Fund for foreign aid. What has changed since then to ensure that the Department can effectively use an almost $300 million appropriation from the Fund in fiscal 1991?

Admiral Watkins. The FY 1990 OMB approach was based on the assumption that without the necessary permits, the scientific investigation program at Yucca Mountain would be limited to current technical activities only. In FY 1991, permits are expected as the result of current litigation. The program feels that at the requested FY 1991 funding level, it can conduct a technically-sound, integrated site investigation program, support the initiation of generic monitored retrievable storage design efforts, continue cask design verification testing in support of the transportation program, and maintain ongoing FTE support as well as provision for administrative and technical support.

SUPERCONDUCTIVITY

Mr. Myers. Please identify and explain the Department's budget requests for superconductivity research and development. How does this compare to the program in fiscal 1990?

Admiral Watkins. The Department of Energy programs in Energy Research, Conservation and Renewable Energy, Bonneville Power, and Fossil Energy sponsor superconductivity research and development; the largest of these are in Energy Research and Conservation and Renewable Energy. Coordination of the superconductivity programs is accomplished through the DOE Energy Materials Coordinating Committee's Subcommittee on Superconductivity. The Department's budget for superconductivity research and development is stable. The fiscal 1990 budget for these programs was $147.7 million, including $113.4 million for low temperature superconductors and $34.3 million for high temperature superconductors. The fiscal 1991 request is for $148 million, with $104.4 million for low temperature superconductors and $43.6 million for high temperature superconductors. Research and development of high temperature superconductors is stabilizing following the establishment of this field of research in fiscal 1987 as a result of the discovery of the ceramic superconductors; the $9.5 million increase from FY 1990 to FY 1991 occurring in the applied program in Conservation and Renewable Energy is to develop materials processing and reliability technologies for generic components, i.e., motors, magnets, heat pumps, etc. The multiple and large-scale applications require a long-term, sustained program. Advances in superconductivity are deemed vital to U. S. competitiveness.

SYNCHROTRON RADIATION

Mr. Myers. Would it be possible to accelerate completion of the 6-7 GeV machine if additional funds were available in fiscal 1991? If so, what additional amount could DOE obligate to the project in fiscal 1991?

Admiral Watkins. We are looking at that question right now and it would appear that the project could be completed one year sooner if additional funds over those requested were provided.

Mr. Myers. Would this result in any overall savings on the total cost of the project?

Admiral Watkins. The ANL proposal would not result in any savings in construction costs since the savings would be used to construct additional user beam lines - the net result being an improved facility from the users' point of view. It would be available one year sooner and have a larger, more varied initial complement of research end stations. The real gain would be the competitive position of the U.S. in this most advanced line of research. We are reviewing this entire situation.

GLOBAL CLIMATE CHANGE

Mr. Myers. Please explain the DOE role in the multi-agency effort regarding global climate change.

Admiral Watkins. DOE supports research directed at the potential impact of energy production and use on climate. Elements of the program include three points.

First, DOE supports a long-standing program of core research on CO_2 emissions from burning fossil fuel, and how this source may be affecting atmospheric CO_2. This research includes modeling the climate response to CO_2, and experiments on the direct effect of CO_2 on vegetation.

Second, a new program on Atmospheric Radiation Measurements (ARM) to detect changes of atmospheric radiation balance and cloud radiative feedback has been initiated. Possible climate change may involve a possible change in radiative balance caused by the increase of CO_2 and other so-called greenhouse gases. The ARM data will be used to improve cloud/climate relationships of general circulation models.

Third, the intercomparison of climate models to determine reasons for disagreements among predictions continues. A new initiative is the application of advanced computer hardware and software, and improved process algorithms for development of an advanced climate model.

Coordination with the multi-agency effort is achieved by participating in the Committee on Earth Sciences (CES). CES is the interagency group formed by the Office of Science and Technology Policy which is planning and coordinating the U.S. Global Change Research Program. The shared planning focuses on key scientific uncertainties and principal priorities. CES also identifies

opportunities for joint programs which lead to innovative approaches for addressing complex problems of global change.

In addition to research, DOE is playing a lead role in developing the Administration's policy on possible global climate change. The Office of Policy, Planning and Analysis (OPPA) has recently released a series of Congressionally mandated reports dealing with various aspects of the climate change issue including a range of policy options for response strategies. OPPA chairs the DOE-wide Council on Global Climate Change and coordinates the related DOE activities including energy conservation and renewable energy development. OPPA is also leading the formulation of the National Energy Strategy (NES) which will take into account the potential of global climate change.

DOE is actively involved in the U.S. activities for the Intergovernmental Panel on Climate Change (IPCC). The IPCC is assessing the science of climate change, examining the possible impacts and exploring the possible mitigation strategies. A draft report covering all three is expected during the next month. Over thirty DOE sponsored scientists are engaged in the IPCC assessment of the science of climate change. DOE staff are also participating in the drafting of the chapters dealing with impacts and mitigation strategies.

Mr. Myers. Where will the Carbon Dioxide Research Program be conducted and at what proposed funding levels in fiscal 1991?

Admiral Watkins. The Carbon Dioxide Research Program will be conducted by national laboratories, universities, other government agencies, industry and other institutions such as the National Academy of Sciences, the National Center for Atmospheric Research, and so on. The approximate percentage for each based on recent funding history is national laboratories 41, universities 42, government agencies 8, industrial organizations 4 and other institutions 5 percent. The amount of funding requested for fiscal 1991 is $66,000,000.

UNIVERSITY RESEARCH INSTRUMENTATION

Mr. Myers. Please provide a table showing how the Department obligated funds during fiscal 1989 in the University Research Instrumentation program.

Admiral Watkins. We would be pleased to provide that information for the record. (The information follows:)

Institution/State	Amount	Instrument
Auburn University, AL	$ 151,967	Pulsed Nd:YAG Dye Laser System
California Inst. of Technology, CA	230,000	HP/X-Ray Diffraction Facility
Stanford University, CA	309,281	Dilution Refrigerator System
Univ. of California, San Diego, CA	300,000	UH/Vacuum Surface Analysis Facility.
George Washington University, DC	146,041	MWPC Neutron Detection System
University of Iowa, IA	234,180	Stopped-Flow NMR Spectrometer
University of Illinois, IL	209,293	Holographic Particle Image Velocimeter
Purdue University, IN	100,669	High-Speed Motion Analyzer
Michigan Technological Univ., MI	350,000	MHV/HR Transmission Electron Microscope
Princeton University, NJ	110,000	Flash-Lamp Pumped Dye Laser
Rutgers University, NJ	184,000	Scanning Tunneling Microscope
Columbia University, NY	325,000	HA/Sensitivity Mass Spectrometer
Cornell University, NY	141,500	Ceramic Materials Image Furnace
Renesselaer Polytechnic Inst., NY	134,549	Laser Doppler Anemometer
SUNY, Stony Brook, NY	190,516	Small Angle X-Ray Scattering Facility
Lehigh University, PA	185,700	Mass Spectrometer
Pennsylvania State Univ., PA	250,000	Femtosecond Laser System
Temple University, PA	250,000	Electron Beam Evaporator and Radiofrequency Sputterer
University of Pennsylvania, PA	160,000	FTIR Emission Spectrometer
University of Tennessee, TN	380,000	500 MHZ NMR Spectrometer
Texas A&M University, TX	134,226	Tandem Mass Spectrometer
University of Wyoming, WY	275,000	NMR Spectrometer
Total:	$4,751,922*	

* Excludes administrative expenses, such as publications.

Mr. Myers. Admiral Watkins, what is your view of the impact which licensing of the Seabrook plant will have on the future of the nuclear option?

Admiral Watkins. Although the licensing of Seabrook may not have any immediate, large positive effect on the future of the nuclear option, the denial of a license would have had a large negative effect. This long delayed licensing action demonstrates once again that nuclear power is an important energy option for the electric utility industry, even in cases where tremendous obstacles must be overcome.

We as a Nation must find a way to make the licensing process more efficient. Nearly two decades to license a nuclear plant costing in excess of $6 billion is unacceptable.

NUCLEAR ENERGY

Mr. Myers. Please justify the reductions in funding below the fiscal 1990 appropriation for the Integral Fast Reactor program.

Admiral Watkins. The FY 1991 funding requested for metal fuel cycle development for the Integral Fast Reactor (IFR) concept within the Advanced Reactor Research and Development (ARR&D) program does reflect a reduction from the FY 1990 level. The FY 1990 work was primarily for facility modifications which is largely completed. The FY 1991 efforts require less funding since they will be for the operation of the facilities with some funding to complete the Hot Fuel Examination-South modifications and initiation of the fuel recycle demonstrations. Also, near-term program priorities in nuclear energy are focused on activities to help remove institutional impediments to any new reactor and these efforts must take precedence versus long-term research such as IFR.

Mr. Myers. Please explain the rationale for proposing the sale of only a portion, the Georgia-Alabama system, of the Southeastern Power Administration.

Admiral Watkins. The rationale for proposing the sale of only the Georgia-Alabama system of Southeastern is primarily because customer groups have previously expressed interest in purchasing this system.

COOPERATION WITH WILDLIFE AND ENVIRONMENTAL GROUPS

Mrs. Smith. Has the Department of Energy been working with national environmental groups, such as the Audubon Society, Sierra Club, National Wildlife Federation and environmental and preservationist groups for their suggestions and counsel with respect to nuclear waste? If so, what is the gist of the advice?

Admiral Watkins. The Department actively seeks comments and suggestions from national environmental groups such as the Audubon Society, Sierra Club and National Wildlife Federation. Environmental Impact Statements on proposals involving nuclear waste routinely are provided to these organizations and their comments are invited.

The Department is currently preparing an update to the Five-Year Plan for Environmental Restoration and Waste Management. We are planning to meet with representatives from special interest groups to discuss the Plan and receive comments on the issues identified in the Plan. Representatives from the national environmental organizations will be invited to participate.

In addition, the Department has involved representatives from national environmental groups such as the ones mentioned above in its ongoing effort to develop a national prioritization system for its environmental restoration and waste management activities. While activities to date have centered on understanding the Department's prioritization methodology as applied to past budgets, reaction to the development of a new prioritization methodology has been very supportive.

Mrs. Smith. Have they suggested that they might contribute money and staff in trying to help you with your effort? Have they been asking you for money to help you carry out your environmental programs?

Admiral Watkins. The Department's interaction with national environmental groups in the review of last year's Five-Year Plan and in the development of a national prioritization system has not elicited any offers for contribution of money or staff. These groups have consistently stated their support for the review and development efforts and their desire to continue to be involved. To date, the Department has not received any official requests for money to continue their participation. The Department continues to pay for travel costs and per diem associated with their travel to attend scheduled review meetings.

CONSULTATION WITH STATES ON CLEANUP

Mrs. Smith. How have the states and local environmental and health agencies reacted to your new policy of "openness" with respect to the military nuclear problems and facilities?

Admiral Watkins. In general, the State and local organizations are pleased with the Department's policy of openness but remain skeptical. In some cases, the Department needs to take additional steps to assure that the policy of openness is fully implemented and we are committed to make that happen. Time will be required for these groups to gain confidence and trust in DOE and its initiatives.

Mrs. Smith. Are the states demanding payments to reach agreements with DOE in its efforts to comply with state and local environmental and health laws? Are these amounts one-time payments or are they likely to grow in scope?

Admiral Watkins. As part of the negotiations for Interagency Agreements for cleanup and compliance with State and local environmental and health laws, involved states have identified a need for resources to accomplish the oversight of activities and the review and approval of documents and planned actions that these Agreements would entail. The States have made payment for these resource needs a prerequisite to execution of these Agreements. The Department has supported these payments for programs that will complement, rather than duplicate those of the Department. Payments to the States have been established as recurring yearly expenses. These payments are likely to increase over time for the foreseeable future as the States gain experience and are able to refine their cost estimates and as the amount of cleanup activity increases, requiring a larger oversight commitment and additional resources to review and approve required documents and actions.

POWER MARKETING ADMINISTRATIONS

Mrs. Smith. Other testimony before our committee indicates that the drought in our western states at least appears to be entering a fourth year. Please provide now or for the record a thorough discussion of the drought's impact on the nation's hydroelectric power production to date, the worst-case scenario for FY 1990 and FY 1991, and what plans or measures the Department of Energy is making or contemplated to offset these effects. What are the major economic impacts of the drought, both short-term and long-term.

Admiral Watkins. Hydroelectric power production throughout the country has been affected by drought conditions in recent years. I have asked the Administrators of the five power marketing administrations to respond, for the record, with the information you have requested.

(The information follows)

ALASKA POWER ADMINISTRATION

Alaskan hydroelectric projects have not experienced drought conditions in recent years. Thus far in FY 1990, water supply conditions are favorable. Given present storage levels, curtailment of power production in 1990 and 1991 due to drought conditions is quite unlikely.

BONNEVILLE POWER ADMINISTRATION

The Pacific Northwest (PNW) suffered through three years of drought, 1986-87, 1987-88, and 1988-89. In these years, the volume of runoff measured 71%, 68%, and 86% of average, respectively. As a result of these low water years, the Bonneville Power Administration (BPA) made no sales of nonfirm energy except during the fish flow operation period. BPA also purchased substantial quantities of energy (1) in place of operating high cost resources and (2) to allow it to serve the nonfirm portion of the Direct Service Industries. The lack of nonfirm sales plus the purchase of resources reduced BPA's revenues below the forecasts of net revenue. There has been no impact on BPA's Treasury payments. All Treasury payments have been made as projected during the last six fiscal years and we are confident that we will make our full planned payment to the Treasury at the end of FY 1990.

During FY 1990, the PNW is not experiencing a drought. The current forecast of volume runoff is 92% of average. BPA is currently in the nonfirm

market selling energy. We do not expect any short-term impacts because of this year's operation. We do not have any knowledge regarding the runoff in FY 1991.

The long term economic impacts of the three year drought are in two areas. The first results from the reaction of the Corps of Engineers (Corps) and the Bureau of Reclamation (Bureau) to concerns of their local constituencies. The reservoirs of both agencies have not been as usable as these constituencies would like. Both agencies have placed new limitations on the use of their reservoirs which will have a potential long-term financial impact on BPA. To the extent that the reservoirs are not usable for power production, BPA must purchase high cost replacement resources. The second long-term impact relates to the first. To the extent that the multi-year drought results in different operations on the Columbia River system, BPA will have to incorporate any resultant needs for greater financial risk protection in setting its electric rates. The majority of the generating utilities of the Pacific Northwest, plus the Bonneville Power Administration, the Corps, and the Bureau, have signed a contract which guides the operation of the reservoirs of the signatories. No other special arrangements are necessary between BPA and the Corps or the Bureau.

SOUTHEASTERN POWER ADMINISTRATION

The projects in the southeastern states have recovered from the prolonged drought of the past several years. During the drought period of 1986-1989, Southeastern Power Administration purchased $26.5 million in replacement energy to meet minimum contractual quantities. During FY 1990, project operations and hydrological conditions are expected to be favorable, with a near normal or better water year. During FY 1989, Southeastern implemented a rate increase which had not been anticipated and additional rate increases are planned for FY 1991 to insure systems repayment in a timely manner.

SOUTHWESTERN POWER ADMINISTRATION

As a result of significantly above-normal rainfall during the months of January and February, 1990, the projects whose hydroelectric power output is marketed by the Southwestern Power Administration (SWPA) have recovered from the effects of drought conditions during 1988 and 1989. Although periods of extremely low rainfall occurred during each of those years, they were of relatively short duration and were followed by periods of abnormally high rainfall. As a result, total hydroelectric energy production during both years was slightly above the long-term average.

Should rainfall in the SWPA region fall to levels experienced during the most critical long-term drought of record, SWPA would be required to acquire about 550,000,000 kilowatthours (kWh) of energy from other sources in order to meet contractual obligations during FY 1990 and FY 1991. We estimate that over half of the energy would be purchased at a cost of about $9 million, with the balance being received though energy banking arrangements.

WESTERN AREA POWER ADMINISTRATION

As of March 1, 1990, drought conditions continue to prevail throughout the Western Area Power Administration's (WAPA) service area resulting in below-normal reservoir storage in the Missouri, Colorado, and Sacramento river basins. Federal hydroelectric generation was about 80 percent of normal in FY 1989. Current predictions indicate that hydroelectric generation may be as low as 79 percent of normal in FY 1990, even with normal streamflow, simply

because of the need to refill reservoirs. WAPA's power purchases are directly related to generation levels, which are dependent on water conditions. If drought conditions continue through the remainder of FY 1990, estimated power purchases could equal or exceed the FY 1989 high of 8.34 billion kilowatthours. Non-Federal power generation capabilities should be sufficient to allow WAPA to purchase any power needed to meet contractual commitments.

Alternative financing arrangements, such as net billing, bill crediting, reimbursable authority, and non-appropriation transfers are used to fund a large portion of WAPA's purchase power and wheeling program activity in FY 1991, thereby, minimizing appropriations requests. In FY 1990, Congress authorized WAPA to use its continuing fund to defray power and wheeling expenses during periods of below-normal hydropower generation, as an alternative to requesting supplemental appropriations. WAPA is using the continuing fund to supplement power purchases for the Pick-Sloan Missouri Basin Program and might use it for the Colorado River Storage Project.

Mrs. Smith. Does the Department work with other agencies, such as the Corps of Engineers and the Bureau of Reclamation, in addressing drought problems? What has been the gist of any recent or current discussions with these agencies?

Admiral Watkins. The Department of Energy, as a member of the Interagency Drought Policy Committee, continues to work with a variety of other agencies, including the U.S. Army Corps of Engineers (Corps) and the Bureau of Reclamation (Bureau), to address drought situations. The power marketing administrations (PMAs) work closely with the appropriate regional contacts of those agencies (Corps - all PMAs; Bureau - Bonneville and Western Area Power Administrations only). I have asked the PMA Administrators to respond, for the record, with a summary of recent drought-related discussions or activities affecting their marketing area.

(The information follows)

DROUGHT ACTIVITIES

The Bonneville Power Administration (BPA), the Corps, the Bureau, and a majority of the generating utilities of the Pacific Northwest, have signed a contract which guides the operation of the reservoirs of the signatories. Also, as mentioned above, the Corps and the Bureau have added new limitations to their reservoir operations as a result of the drought. There is also a long-term process now underway in which all three agencies, BPA, Corps, and the Bureau, are analyzing the operation of the reservoir system and determining the tradeoffs between the power operation and the limitations on reservoir operation due to nonpower needs.

The Southeastern Power Administration (SEPA) continues to work with the Corps of Engineers in addressing drought problems. A degree of concern is present should the Corps implement their "Water Control and Drought Contingency Plan" in the event streamflow conditions fall below normal, causing SEPA to purchase replacement energy to meet minimum contractual quantities.

In the Southwestern Power Administration (SWPA) marketing area, the Corps of Engineers is in the process of developing drought contigency operating plans for each of their projects. SWPA has been provided an opportunity to review and comment on those plans. In addition, SWPA is developing a plan for managing hydroelectric power operations during drought conditions. That plan

includes the use of rainfall and soil moisture data to forecast an impending drought. The SWPA plan is intended to insure that hydroelectric power operations are adjusted to reflect anticipated drought conditions rather in reaction to existing drought conditions as provided in the Corps' drought contigency plan. SWPA has also indicated an interest in participating in the Corps' National Water Management During Drought Study being undertaken by the Institute for Water Resources.

The Western Area Power Administration (WAPA) coordinates daily with both the Corps and the Bureau in operating the river systems in WAPA's service area. The most notable drought-related coordination, however, has been on the Missouri River due to the intense interest of the Governors of the Upper Missouri River Basin states. WAPA contributed to the Corps' recently-released "Plan of Study for the Review and Update of the Missouri River Main Steam Master Water Control Manual" and plans to stay involved as the study progresses.

RENEWABLE FUELS

Mrs. Smith. I also will be asking tomorrow in greater detail about the Department's commitment to allocating resources to such renewable fuels as ethanol from agricultural sources.

Basically, what maximum role do you envision for ethanol both as an essential fuel and as a way to reduce air pollution in certain urban areas?

Admiral Watkins. Ethanol is one of a number of alternative fuels that we expect to play an increasing role in the nation's mix of liquid transportation fuels. Like many of those fuels, ethanol is oxygenated, has high octane, and has a low vapor pressure when pure. All of these characteristics will improve air quality, particularly in the more heavily populated urban areas of the country. Depending on its competitiveness in various markets, we envision ethanol serving as a blending agent with gasoline, as the principal constituent of an octane enhancer, or as a direct prime fuel.

Mrs. Smith. Do you assume that ethanol would have a more important role in our national mix of future energy resources than methanol, or a lesser role? Would you please explain your answer for the record.

Admiral Watkins. The Administration and my position both are that the market place should make the ultimate decision of the mix of alternative fuels. The testimony at the National Energy Strategy meetings has made it clear that we must develop the capability to include all the costs of the fuel cycle in the market place decision. Further, Department of Agriculture Secretary Yeutter and I chaired the National Energy Strategy hearing in Omaha in December and both came away assured that agriculture and forest resources can make a significant contribution to our transportation fuel requirements without adversely affecting food crop output. This is particularly true since Secretary Yeutter has identified the need for new crops for 150 million acres of current farm land in the 2010 time frame, while we expect to have advanced technology available in 2000 for industry to apply to the conversion of cellulose to ethanol. While biomass may be converted to either methanol or ethanol, program data suggests biomass-to-ethanol is the more economic fuel pathway at this time.

CLEAN AIR ACT

Mrs. Smith. If current Clean Air Act Amendments as being considered by the Senate were enacted as law, how much would overall energy costs rise or fall as a result of implementation in both short-term and long-term?

Admiral Watkins: The Department of Energy has not developed independent cost estimates on the short- and long-term energy costs of the compromise Clean Air Act amendments as developed by the Administration and Senate leadership. Overall cost estimates were developed for the Administration proposal and the Senate Committee on Environment and Public Works proposal, S. 1630. EPA/ICF estimated that, on a national basis, the President's proposed acid rain legislation would increase electricity rates by no more than 2 percent with regional increases up to 5 percent. Due to its more stringent NO_x provisions, S. 1630 would result in additional rate increases

There has not been sufficient time to develop new cost estimates for the short- and long-term energy price impacts of the recent compromise between the Administration and Senate leadership.

GROUNDWATER MONITORING SOUTH CAROLINA/GEORGIA

Mr. Thomas. In a November 1989 correspondence to my office, Under Secretary John Tuck provided information that stated: "numerous independent studies to date indicate that groundwater in the cretaceous aquifers cross from South Carolina into Georgia." Has the Department of Energy (DOE) completed its agreement with the U.S. Geological Survey to conduct a groundwater monitoring program, and does it include Georgia?

Admiral Watkins. A meeting is scheduled with the USGS for March 12, 1990, to discuss and refine the Scope of Work associated with a USGS proposal to study the potential for underflow of groundwater from east to west under the Savannah River. This work will be performed under a Memorandum of Understanding between DOE-SR and the USGS dated April 1989 (DE-MU09-89SR18024). The USGS Water Resources Division, Columbia, SC, will take the lead role in coordinating work scheduled to be performed by the USGS in Georgia. It is anticipated that the appropriate State agencies from both South Carolina and Georgia will also participate in this study to confirm the accuracy of the existing hydrologic data base information. Current data actually suggest that such underflow of groundwater does not occur beneath the Savannah River in the vicinity of SRS.

NOTIFICATION OF SPILLS OR RELEASES OF HAZARDOUS CONTAMINANTS

Mr. Thomas. In the same November 1989 response from Under Secretary Tuck, he indicated that DOE has "been aggressively pursuing an improved notification system for SRS: regarding spills or releases of hazardous contaminants. Has this system been completed and implemented yet?

Admiral Watkins. The new system for reporting operational incidents has been implemented. Under this system, which is known as the Site Item Reportability and Issue Management (SIRIM) System, those events which fall under the emergency action level are automatically reported via the Emergency Notification Network to others, including the State of Georgia.

Notifications of incidents (spills, releases, etc.) that do not meet the emergency action levels are made via one of two potential routes. If the incident could impact Georgia, notification would then be made to the State Department of Natural Resources. Secondly, notification of any radiological release that occurs at SRS is made through the Data Exchange Network, of which the Georgia Department of Natural Resources is a member.

Annually, the Savannah River Site issues an Environmental Report which is transmitted to the Federal and State environmental regulatory agencies including the Environmental Protection Agency Region IV and the States of South Carolina and Georgia. This report includes those spills and releases that have occurred during the previous Calendar Year, and also provides a verification of the reporting that occurred.

MONITORING AGREEMENTS WITH STATES

Mr. Thomas. In your news release of February 7, 1990, you indicated that DOE had invited the Governors of eleven states hosting DOE nuclear facilities to negotiate agreements for environmental monitoring and other activities. Do you also intend to involve contiguous states, such as Georgia, in this process?

Admiral Watkins. At the present time, the Department is concentrating on developing monitoring agreements with those states that are hosts to our nuclear facilities. These agreements are meant to enhance state oversight and confirmatory monitoring for our facilities, and therefore we would seek to continue any such existing arrangements with contiguous states. It is our plan to extend this network of agreements to include other state as appropriate once this first phase of negotiation has been successfully concluded.

CENTRAL TRAINING ACADEMY FIREARMS TRAINING SIMULATOR

Mr. Thomas. In the past hearings, I have asked questions about the program by the Central Training Academy (CTA) of the Department of Energy (DOE) to develop a customized interactive laser video simulator for firearms training by DOE Security Inspectors. Although I realize that DOE has initiated an investigation of this project by the Inspector General, I would like information regarding the status of this ongoing procurement in terms of its cost and status. Specifically, what is the current total expenditure for all costs from all accounts to develop and build this simulator? Are any systems currently in regular, scheduled use at the CTA? Are any in regular use elsewhere?

Admiral Watkins. The R&D cost associated with development of the interactive laser video system was approximately $434,000. It should be noted that the procurement and use of the system is limited to DOE and their contractors. A system is in use at CTA for two firearms courses and for demonstration purposes to DOE field units. These systems are used also at the Tonopah Test Range, Nevada Test Site, and the Headquarters Office of Security Evaluations. The Sandia National Laboratories and Richland has inquired regarding possible use pending budget consideration.

CENTRAL TRAINING ACADEMY FIREARMS TRAINING SIMULATOR

Mr. Thomas. What is the current anticipated future expenditure for production and operation of these simulators?

Admiral Watkins. Cumulative anticipated future expenditures for production for FY 1990 and FY 1991 is approximately $330,000.

CENTRAL TRAINING ACADEMY FIREARMS TRAINING SIMULATOR

Mr. Thomas. Based on current cost data and the stated requirement in 1986 that this system was needed on an emergency basis, does the Department of Energy now believe that this system should have been put out for bid in a standard procurement process?

Admiral Watkins. I will be able to answer your question definitively within the next 30 to 45 days. My staff has now received the Inspector General report and will be reviewing its findings and recommendations. I will be happy to get back to you very shortly following the review.

CENTRAL TRAINING ACADEMY FIREARMS TRAINING SIMULATOR

Mr. Thomas. Does any Department of Energy (DOE) contractor involved in this project plan to market a similar system in the private sector for profit? Does DOE have any plan to share technical or other data for its system to any other entity for ultimate commercial sales?

Admiral Watkins. As indicated earlier, I will not be able to answer definitively the first part of your question for about a month. It is DOE's policy to release this type of information, subject to administrative, security, and other restrictive issues relative to technology transfers.

SUPERCONDUCTING SUPER COLLIDER

Mr. Chapman. Could you briefly describe the major elements of the recently developed site-specific design of the Super Collider and the benefits of this design?

Admiral Watkins. The major elements of the recently developed proposed site-specific design of the Super Collider are: increased injection energy from 1 TeV to 2 TeV, increased collider dipole magnet aperture from 4 centimeter to 5 centimeter diameter, and a slightly larger circumference to 54 miles. This design, which builds on the 1986 conceptual design and takes into account all new technical information available, will enable the Super Collider to meet the energy and luminosity goals set for it with less risk and permit a shorter commissioning period.

Mr. Chapman. Isn't it true that we have the capability to make superconducting magnets industrially reproducible?

Admiral Watkins. Yes. Superconducting accelerator magnets of design similar to the SSC have been successfully manufactured by European firms for the new Hadron Electron Accelerator (HERA) facility in Germany. Several U.S. firms also appear to have the capability for making these magnets reproducibly. The next step in the SSC magnet industrialization program is to bring industry's manufacturing expertise to bear in the final development stages to ensure cost-effective and reliable manufacture of these magnets.

Mr. Chapman. Isn't the focus of the R&D effort at this time the perfection of the magnets particular to the needs of the Superconducting Supercollider, not of creating superconducting magnets in general?

Admiral Watkins. Yes. The past decade has seen a considerable increase in our experience with superconducting magnets for many purposes, and accelerators in particular. The Tevatron at Fermilab, which came into operation in 1983, shows that superconducting magnets can be successfully used for high energy accelerators. The HERA facility is nearing completion and the UNK project in the Soviet Union is well underway. We are fortunate to be able to build upon the previous experience and investment in this technology. The SSC magnets do need to have the engineering details finalized, including the changes in size as we go from a 4 centimeter bore to 5 centimeter. As we move into the manufacturing phase we will also need to demonstrate the fabrication processes needed for reliable, cost-effective production of the magnets.

Mr. Chapman. So wouldn't you agree that a much shorter step in the research scheme is necessary for the SSC at this point, than, for instance, in the ISABELLE project when that project failed?

Admiral Watkins. Yes, we are well along in the magnet R&D needed for the SSC. I might point out that at the time of the ISABELLE project there were no operating superconducting accelerators. A great deal has been accomplished in this area over the past decade.

Mr. Chapman. What has been the success rate of superconducting magnets that have been tested to date?

Admiral Watkins. About two years ago, a major step in the mechanical design of the SSC magnets was taken -- firm clamping of the collared coil using the iron yoke. Since that time, all but one of the seven long magnets were successful, going to the full operating field of 6.6 Tesla on the first or second excitation. The remaining magnet had a quality control error -- someone wound a cable leader into the magnet; considering this, even this magnet worked amazingly well.

Mr. Chapman. Has anyone built superconducting magnets with a 5 cm aperture before now?

Admiral Watkins. Yes, there is nothing magic about 5cm and we do not expect any significant difficulties in going to 5cm. The Large Hadron Collider at CERN in Switzerland is designed for 5cm and some short models have been built. A 5cm magnet was recently built at Lawrence Berkeley Laboratory to test SSC cable samples. Other superconducting accelerators built, or under construction, have even larger aperture: the Tevatron and HERA magnets have 7.5cm bores, while the UNK and Relativistic Heavy Ion Collider accelerators will have 8cm bores.

Mr. Chapman. With regard to reliability of experiments, how do superconducting magnets with 5 cm aperture compare to those with 4 cm?

Admiral Watkins. Magnet reliability should be comparable at 5cm to that at 4 cm. The 5cm magnet may even have greater margin, that is, higher field, than the 4cm. The beam stability should be substantially improved at 5cm, however, and that was the reason for the change from 4cm to 5cm.

Mr. Chapman. In the FY 90 Energy and Water Development Appropriations Bill, Congress clearly directed the Department of Energy to proceed with an international participation plan. I understand that informal teams have been sent abroad to ascertain potential SSC participation. What prospects do you see for international participation?

Admiral Watkins. As it becomes more and more apparent that the SSC represents a commitment of the United States, the prospects for international participation are enhanced. Interactions in the scientific community, between U.S. scientists and their foreign counterparts have been intense this past year. At present, we think the interest in some of the Economic Summit countries and certain other countries is very high; how much that interest will translate into actual participation will depend upon negotiations, which we are preparing to begin in the near future.

Mr. Chapman. When will an international plan be complete?

Admiral Watkins. The International Plan has been reviewed by an interagency group and is now being finalized. Because of the sensitive negotiating material contained in the document, the document has been classified. We are also working on an unclassified plan.

We expect that the international plan, once approved, will be a living document, updated periodically to reflect progress in negotiations, the status of the SSC program, revised legislation, and any changes in Administration policy or guidance.

Mr. Chapman. Is the $318 million requested by the Department for the SSC in FY 91 enough to keep the project moving forward in a timely fashion?

Admiral Watkins. Yes, the $318 million requested by the Department for the SSC in FY 91 is consistent with the progress and readiness of the project and will permit the project to move forward in a timely fashion.

Mr. Chapman. Is the $318 million request enough to do the kind of research and development necessary this coming fiscal year?

Admiral Watkins. Yes, the $318 million request is enough to do the kind of research and development necessary this coming fiscal year. The $318 million includes $116 million in operating funds and $33 million in capital equipment, mainly for the research and development program. A strong focus of the research and development effort will be on completing the design of the superconducting dipole magnets. The remaining amount of $169 million, in construction funds, will be used primarily for detailed design and for the magnet industrialization program.

Mr. Chapman. With regard to the SSC project, what would you like to see accomplished before the end of the current fiscal year?

Admiral Watkins. The proposed footprint recently has been identified. The supplemental environmental impact statement possibly will be completed before the end of the fiscal year. In addition, most of the key permanent DOE management staff within the Office of Superconducting Super Collider should be in place, both at Headquarters and at the site project office. The Project Management Plan should be completed. The formal agreement between DOE and the Texas National Research Laboratory Commission, setting forth procedures for handling the $1 billion contribution, should be signed by both parties. The architect-engineering/construction management contract should be awarded. We also plan to have an industrial contractor selected working on magnet industrialization.

Mr. Chapman. Would your tentative agenda include starting the land acquisition for the project?

Admiral Watkins. Land acquisition is the responsibility of the State of Texas. As soon as we release the proposed footprint, we expect that Texas will proceed to issue the bonds whose proceeds are needed for land acquisition.

Mr. Chapman. Would your tentative agenda include groundbreaking?

Admiral Watkins. At this time we have not scheduled the groundbreaking ceremony.

Mr. Chapman. Would your tentative agenda include completion of the supplemental Environmental Impact Statement?

Admiral Watkins. The SEIS is scheduled to be completed late this fiscal year or early next fiscal year, followed closely by a Record of Decision.

Mr. Chapman. Would your tentative agenda include signing the contracts for production of the dipole magnets?

Admiral Watkins. A Request for Proposals for industrial development of the final design of the collider dipole magnets and development of reliable cost-effective manufacturing techniques will be issued and a selection made this fiscal year.

Mr. Chapman. Would you agree that signing a contractor for the magnets would be more feasible if the Department had an international participation plan in hand?

Admiral Watkins. The international plan will not affect the magnet procurement. It is currently planned to have bidders provide prices for varying numbers of magnets to allow for the possibilities of magnet donations from foreign countries.

Mr. Chapman. The Department of Energy has recently announced the Architectural-Engineering/Construction Management (A-E/CM) team that will oversee the construction of the Collider. Accelerators are generally managed by physicists, but the Department has hired an industrial partner to aid in the construction management of the SSC Laboratory. What advantages does this offer in bringing the Collider in on time and on budget?

Admiral Watkins. Our plan is to make best use of a combination of scientific and industrial talents to ensure that the project is constructed expeditiously and on time and budget. As for previous large accelerator projects, the scientists provide the overall management needed to optimize the facility for research and to design and oversee the technical systems needed for the accelerators. An A-E/CM firm is brought in to design and manage the conventional or civil construction -- buildings, tunnels, etc. In addition, for the SSC, industrial firms are working very closely with the scientists to bring additional, complementary expertise such as systems engineering and integration to the project. Industrial expertise will also be brought to bear on manufacturing the various components, in particular the magnets.

Mr. Chapman. Considering that contract negotiations will not be finished until early spring, when will the A-E/CM contractor's revision of the cost estimate be complete?

Admiral Watkins. While the A-E/CM contract is not expected to be signed until this summer, the SSC Laboratory is currently evaluating a number of procedures for bringing a small cadre of staff from the selected A-E/CM to the Laboratory prior to finalization of the contract. The A-E/CM staff will assist in the cost estimating process. It is quite likely that these staff members will join the Laboratory this spring and participate to some extent in the development of project cost and schedule and in the review that will lead to project validation.

Mr. Chapman. When do you anticipate the magnet industrialization program will be demonstrated?

Admiral Watkins. It is anticipated that sufficient progress will have been made by September 1992 to successfully test a string of about 25-50 industrially produced preproduction prototype magnets. At that time, we should be prepared to place a large order for commercially produced magnets and to begin testing the reliability of production models. Important intermediate goals include successful testing of a 5 cm aperture short magnet by December 1990 and successful testing of a full length 5 cm aperture magnet during summer 1991.

Mr. Chapman. What is your opinion of the SSC's potential for producing important scientific knowledge?

Admiral Watkins. I am very enthusiastic about its potential for making important scientific discoveries. It will open a new energy frontier, permitting exploration of a domain of physics research which cannot be reached by any other facility in existence or planned. I am also very enthusiastic about its potential in the area of education and its serving as a beacon to attract some of our finest young minds into scientific and technological careers.

Mr. Chapman. The SSC is a good example of a project which relies on the expertise of skilled craftsmen to translate scientific advances into industrial technology. Don't you agree that the SSC will yield important benefits to industry as well as the scientific community?

Admiral Watkins. The Super Collider is an excellent example of a high technology scientific endeavor that requires close collaboration between industry and the Government. Although the project does include some ordinary civil construction such as buildings and tunnels, the real challenge will be with the technical systems such as the collider dipole magnets. The project will yield important benefits to industry, especially in the area of superconducting technology, as well as being a superb scientific instrument.

PETROLEUM AND NATURAL GAS RESEARCH AND DEVELOPMENT

Mr. Chapman. In light of the recent surge in the rate of imports of crude oil, which reached 54% during the month of January, what role do you think federal funding for research for enhanced recovery of domestic oil and natural gas should play in a comprehensive strategy?

Admiral Watkins. The Department has been revising the program strategy in this very important area. Last January, Deputy Secretary Moore held a public meeting to get comments on our Geoscience Strategy and the associated implementation plans for oil and gas. These comments have been received, studied, and revised. These documents will be delivered to the Congress shortly. Our conclusion, based upon the comments received from the oil and gas community, is that the federal program should focus on improving the effectiveness of recovery technology so that a greater fraction of the discovered resource is ultimately produced. In the case of oil, where our largest fields are quite mature, we are faced with potential loss of continuing access to the target oil through abandonment for economic reasons. Thus, there is an immediate need to work with all segments of the industry to slow abandonment of wells that have a high potential for future production. In the mid-term, the oil program should develop, test, and transfer the best extraction technology possible to operators of the reservoirs with the greatest potential for incremental recovery. In gas, the near-term effort emphasizes the gas remaining in conventional reservoirs after conventional production has declined below economic levels. In the mid-term, the gas program will focus on the economic producibility of known, unconventional resources such as tight sands.

Mr. Chapman. In particular, with the estimates of the natural gas resource base now at 1,059 trillion cubic feet (DOE estimate) to 2000 tcf (American Assn of Geologists), what role do you envision natural gas playing in a comprehensive energy strategy?

Admiral Watkins. The Department of Energy (DOE) is developing a National Energy Strategy (NES) to balance our energy, economic and environmental requirements. Natural gas has many attributes that will enable it to make an important contribution to such a comprehensive energy strategy.

The U.S. is endowed with a large natural gas resource base. The DOE has estimated that the Nation has a 35-year supply of natural gas at consumption rates of 17 trillion cubic feet (tcf) a year and prices of $3.00 per thousand cubic feet (mcf) or less. We currently use about 17 tcf of gas per year. At prices in the range of $3.00 - $5.00 per mcf, our supplies would extend far longer.

In many applications, natural gas can be substituted economically and easily for oil, thus lessening the need to import oil from potentially insecure sources. At a time of growing concern over the pollution of our Nation's air and water, natural gas provides a clean-burning fossil energy option. As a result of the 1989 passage of wellhead price decontrol legislation, consumers will have the benefits of the availability of greater supplies of lower cost gas, and the market operates more efficiently as a result of clearer price and supply expectations.

During the last decade, the Federal Energy Regulatory Commission has taken many actions designed to promote competition and deregulate the natural gas marketplace. Additional statutory and regulatory reforms are desirable. Further reform should focus on three areas: making new capacity available, providing proper rate incentives, and eliminating unnecessary regulation of pipeline gas costs. The NES process will be useful in helping us to identify and design ways to remove any remaining regulatory, economic or institutional obstacles to the full utilization of natural gas.

Opportunities for increased gas use are many. There have been innovative demonstrations of gas use in transportation, where gas-derived fuels are likely to become increasingly important in meeting clean air objectives. Another fast growing market for natural gas is the electricity sector, where a variety of technologies support its use. We view it as our responsibility, at the Federal level, to foster policies that allow the industry to compete on a level playing field with other fuels and to make quick adjustments to whatever demand develops in the marketplace.

ENERGY SECURITY

Mr. Chapman. What implications do the rising rates of oil imports have for U.S. energy security?

Admiral Watkins. The Department is concerned about the Nation's increasing reliance on potentially insecure sources of petroleum. In 1989, imported oil accounted for 41 percent of domestic consumption, the highest percentage since 1979. Increasing consumption and declining domestic production indicate that our oil imports will continue to rise in the future. In our view, allowing oil imports to increase, when there are economical ways to reduce them, is a mistake. We should do all we can, within the bounds of sound policy, to reduce our reliance on oil imports.

The Department is now developing the National Energy Strategy, an action plan designed to provide this Nation, in the years to come, with adequate supplies of competitively priced, clean energy. In carrying out this responsibility, we believe that it is important to consider all relevant factors so that we will have well-balanced policies for obtaining secure, economical energy supplies.

Changes in the oil market and in geopolitical conditions over the last decade, such as the creation of large government

stockpiles and investment by OPEC nations in refining facilities in consuming countries, have acted to reduce our vulnerability to oil supply disruptions. We are not as dependent on oil imports as Germany and Japan. We have a large Strategic Petroleum Reserve growing toward the 750 million barrel target level. We have abandoned the discredited price control and allocation program that existed in the 1970s and contributed to the shortages and gas lines. These factors in combination mean that oil imports are not as great a threat today as they were in the past, but they are still a cause for concern.

To reduce U.S. oil imports, we must pursue every alternative available that is consistent with sound economic policy and respectful of the environment. We are examining a number of options within the context of the National Energy Strategy. They include Federal and State incentives for domestic oil and gas production; continuing to make gains in conservation and energy efficiency; removing statutory and regulatory barriers to increased use of natural gas; exploring leasing as a means of filling the SPR to its goal of 750 million barrels; pursuing alternative fuels for transportation, if they make economic sense; and supporting, where appropriate, research and development programs for renewable energy resources, enhanced oil recovery techniques, and other energy sources. -

PETROLEUM AND NATURAL GAS RESEARCH AND DEVELOPMENT

Mr. Chapman. On page 1-667 of the FY 1991 Budget of the United States Government, under Fossil Energy Research and Development, language states that "$17,000,000 is for implementation of one or more oil and gas recovery and geoscience consortia with universities and industry, in which each consortium provides at least 50 percent cost-sharing from non-Federal participants..." Could you outline the Department's goals for this proposal?

Admiral Watkins. The $17 million is included in the requests for three programs in the area of oil and gas technology development. The largest increment, $10 million, is in the Enhanced Oil Recovery program with the goal of initiating efforts in high priority reservoir classes. High priority reservoir classes will be defined on the basis of future production potential with advanced technology, risk of abandonment, and, possibly, other factors. The Unconventional Gas Recovery program contains a request for $4 million with the goal initiating efforts in conventional gas reservoirs and developing sound problem definition. The last increment, $3 million, is in the Advanced Extraction and Process Technology program, and funds will be utilized for fundamental geotechnology research that addresses issues relevant to both oil and gas.

DOE FACILITIES CLEANUP

Mr. Chapman. Mr. Secretary, you note (on page 3 of your testimony) that the estimated cost identified by the Five-Year Plan is $19 billion for FY 1990-1995 for "completing the highest priority activities..." What is your best estimates as to the complete long-term timetable for the cleanup of DOE facilities and the long-term costs?

Admiral Watkins. In the August 1989 Environmental Restoration and Waste Management Five-Year Plan, the Department committed to the goal of cleanup of its facilities and sites within 30 years. The Department recognizes that attainment of this goal will require successful development and implementation of new technologies. Nevertheless, the Department remains committed to this goal.

The Department has not performed an overall analysis to determine a total cost of cleaning up its entire nuclear complex. For reasons given below, the Department does not believe it appropriate or possible to do so at this time, and any estimate of a hypothetical total cost would likely be misleading.

Although DOE attempts to develop accurate cost estimates in order to request adequate funds for carrying out cleanup activities, areas of considerable uncertainty exist with regard to such costs. Costs are strongly dependent on the requirements, extent, and nature of individual cleanup actions; and estimates of cost reflect the degree to which the aggregate of engineering and remedial work connected with specific sites progresses, becoming more detailed and precise as work proceeds. The cleanup of DOE's installations is in a comparatively early stage of implementation. Although many cleanup actions are underway, the major fraction of current

specifications concerning the nature, extent, amount of contamination, required technology, and specific cleanup action are based, generally, on data derived from ongoing site assessments. Consequently, most current cleanup cost estimates should be considered to be projections based on what has been learned from, as yet, incomplete characterization of known sites. Such projections reflect only partial technical data, assumptions concerning significant cleanup needs, and possible methods of accomplishing cleanup tasks.

Based on the results of ongoing site assessment and cleanup work, DOE continually updates its estimates of program cost. Such cost updates are to be reflected in each annual revision of the Environmental Restoration and Waste Management Five-Year Plan.

TRITIUM FOR WEAPONS COMPLEX

Mr. Chapman. The continued delays in the restart dates of the Savannah River facility has serious implications for the supply of tritium necessary for the nuclear weapons complex. Has the lack of new supplies of this critical material reached a crises level yet, and if not, at what point do you anticipate such a shortage will compromise the effectiveness of the weapons complex?

Admiral Watkins. The lack of supply of new tritium has not reached crises levels. Restarting the Savannah River reactors on their current schedules as discussed previously will avoid an impact on the weapons stockpile. The timing of when specific impacts will occur is classified and will be discussed in the Defense Programs hearing on March 12 and 13.

NUCLEAR WASTE DISPOSAL

Mr. Chapman. On page 4 of your statement, Mr. Secretary, you outline a three-point plan for near-term and long-term waste disposal, which includes restructuring the Office of Civilian Radioactive Waste Management, initiatives to gain access to the Yucca Mountain site, and an initiative for establishing an integrated Monitored Retrievable Storage (MRS) facility to begin spent fuel acceptance in 1998. Can you expand on the actions necessary to implement this plan? Do you see major obstacles to such implementation?

Admiral Watkins. First of all, Mr. Chairman, we are preparing a new Mission Plan to be issued in June that will amplify on the Department's plans. To briefly summarize where we are today, we are hopeful that President Bush's nominee, Dr. John W. Bartlett, will soon be confirmed as Director of the Office of Civilian Radioactive Waste Management (OCRWM).

We are implementing recommendations emerging from a recent independent management review of the program. I have established direct line reporting of the Yucca Mountain Project Office to Headquarters; a review is being conducted with an eye to streamlining contractor support, and we are reviewing our process for interacting with all outside organizations.

We have established program goals, schedules and baselines that are based on sound scientific principles and data and that take account of conditions beyond DOE's immediate control, such as obtaining permits necessary to begin scientific investigations at the Yucca Mountain candidate repository site.

In response to the State of Nevada, the NRC and others, we intend to focus early site characterization studies on potentially adverse conditions that might disqualify the site. At the same time, we are working with the U.S. Department of Justice to seek legal remedy against the State of Nevada to acquire all necessary permits so that the Federal law to characterize the site can be carried out.

We are reviewing the MRS Review Commission's Report to Congress to take advantage of their insights and, at the same time, we are examining other options to enable the Government to accept spent fuel from the utilities in a timely manner. We are working to facilitate Presidential appointment and Senate confirmation of a Nuclear Waste Negotiator who would help us search for a State or Indian Tribe willing to host a repository or MRS facility.

As you know, this program continues to face significant institutional and technical challenges. We are confronted with a lawsuit filed by the State of Nevada that aims to halt the program. Recognizing and responding constructively to the public's concerns about nuclear power and nuclear waste disposal is a formidable challenge. Demonstrating that a geologic repository can provide the required isolation of nuclear waste for thousands of years is an unprecedented technical and regulatory effort. We are aware of these obstacles to success, and we are developing contingency plans that will allow the program to proceed.

SUPERCONDUCTING SUPER COLLIDER

Mr. Conte. Last year we discussed foreign participation in construction of the SSC. Proponents of the project suggested that it was critical for the U.S. to first demonstrate its support for the SSC with a significant appropriation. We were told that such a commitment would be necessary to generate foreign confidence in the project. We were also informed that such a financial commitment would have to precede effective efforts to obtain foreign participation. Congress appropriated $225 million to the project for FY 90. How much foreign participation has that appropriation leveraged? How much more will Congress have to commit before substantial sums can be raised from other countries?

Admiral Watkins. The FY 1990 appropriation for construction has given the project credibility in the international community. Already we are seeing scientists in other countries readjusting their research programs to take advantage of the opportunities that the SSC represents. Governments, who are concerned about the reliability of the U.S. as a partner, are closely watching appropriations to the program. Appropriations send a critical signal on the vitality of the project and its importance to the country. Last year's appropriation did not leverage any foreign participation because we put a hold on aggressively pursuing any international contributions until the cost and scope issues were decided.

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sums available for expenditure only after non-Federal contributions have been pledged to the project?

Admiral Watkins. We certainly need to develop a way to assure that foreign contributions are committed before the Federal government spends all of its share of the SSC funds. We do not want to find ourselves in a position where the Federal government has spent its own share, only to find out that foreign contributions will not be forthcoming. Fenced appropriations would probably not work if the funds for an entire year could only be released after the entire non-Federal share for that year were in hand. We believe that the best course of action is to initiate soon the next round of discussions on potential foreign participation.

Mr. Conte. The SSC, as I understand it, is a "pure science" project, designed to discover the smallest constituents of matter and possibly lead to a new understanding of the origin of the universe. New knowledge developed by the SSC will be freely available to the international physics community, won't it? If so, why shouldn't we impose hard and fast requirements for foreign financial participation in the project?

Admiral Watkins. Yes, new knowledge of basic science developed by the SSC will be published and freely available. All experiments carried out on the SSC will be chosen on the basis of scientific merit only. There is an international agreement (called the ICFA Guidelines) whereby all countries agree to this principle. Everyone benefits from this principle. While we do expect to get major contributions from several countries, there is no good way of imposing requirements for foreign financial contributions. It must be done by persuasion and negotiations. We participate in foreign science projects which, likewise, do not impose hard and fast financial requirements from us.

Mr. Conte. The State of Texas has agreed to contribute $1 billion to the project. How much of this contribution has been received to date?

Admiral Watkins. The State of Texas proposed to contribute $1 billion to the SSC project to assist in the support of the SSC Laboratory in Texas. None of the contribution has been received to date. The State of Texas needs to issue bonds for this contribution and that action has been on hold until a footprint showing the proposed land requirements has been established. That was delayed until a final decision could be made on the SSC scope, which includes land related design changes. The proposed footprint decision will occur in the near future.

Mr. Conte. Has the State provided a schedule of payments to meet this commitment? If so, please provide that schedule for the record?

Admiral Watkins. The Department of Energy has discussed the form and timing of this contribution with the Texas National Research Laboratory Commission (TNRLC) and has agreed on a general allocation to construction and utilities, research and development and to science education. The DOE is presently discussing a Memorandum of Agreement (MOA) with the TNRLC to define responsibilities and procedures, and to include a schedule and allocation of the funds to be contributed. It is expected that this MOA will be completed by about May 1990.

Mr. Conte. Is it accurate to say that the SSC is currently undergoing a major redesign? If so, how can the Department be sure that the proposed site continues to be the best site for the project?

Admiral Watkins. Yes, we are looking at a number of technical design changes. These technical changes are driven by concerns for rapid initiation of the SSC research program following completion of construction and for highly reliable operation of the SSC. These technical design changes will not affect the overall site characteristics required for the project. Hence, there is no basis to question the site selection.

NUCLEAR WASTE FUND

Mr. Conte. The Department has requested an appropriation of $293 million from the Nuclear Waste Fund for site characterization activities at Yucca Mountain, Nevada. This request is being made at a time when the Department is involved in litigation with the State of Nevada concerning the fate of Yucca Mountain. If the state prevails on at least one aspect of the litigation, the DOE would be barred from pursuing a high-level nuclear waste repository at the Yucca Mountain site. Is this correct? Given the uncertainties of litigation, why should we appropriate a huge sum of money to go full speed ahead on Yucca Mountain activities? Wouldn't it be more prudent to wait until the litigation is concluded before committing another $293 million to the project?

Admiral Watkins. In order to meet our responsibilities in the Civilian Radioactive Waste Management Program, and based on the restructured program and scientific investigation plans, the FY 1991 Appropriation Request of $292.8 million from the Nuclear Waste Fund included approximately $193.2 million for activities associated with the repository studies, which include surface-based testing at Yucca Mountain scheduled to begin in January 1991, assuming early resolution to the permitting impasse in Nevada.

Although the State of Nevada has not issued the necessary permits that would allow us to initiate any new surface disturbing testing, the DOE is attempting to resolve the permit issue at this time through litigation. The Department of Justice, on behalf of the DOE, initiated litigation against the State of Nevada to obtain the necessary permits and the Department is quite optimistic that the Federal case will prevail. Lack of permits has delayed

new surface-disturbing work but has not disrupted many scientific investigation activities to be continued at the Yucca Mountain Project during FY 1991, such as seismic, hydrologic, and meterologic monitoring; studies of volcanic processes and events; laboratory work, such as geochemical and rock mechanics studies; dry drilling prototype testing conducted at non-Nevada locations such as Apache Leap, Arizona; quality assurance activities; and project managerial activities. The appropriation request for the First Repository activities of $193.2 million is primarily for non-surface disturbing efforts at Yucca Mountain. Once the necessary permits are obtained, then the scientific investigation activities that have been delayed by lack of permits can proceed at the required pace.

It is critical that Yucca Mountain retain its core scientific staff assembled and ready to begin new scientific investigation activities immediately upon receipt of the necessary permits from the State of Nevada. The new schedule anticipates receipt of the necessary permits in FY 1991 and start of the shaft in FY 1992.

MAGNETIC LEVITATION RESEARCH

Mr. Conte. The President's budget includes funding for research into magnetic levitation or "MagLev." Funds are requested for the Department of Transportation and the U.S. Army Corps of Engineers. Is the Department of Energy going to jump on the MagLev train and participate in MagLev research and development efforts?

Admiral Watkins. During fiscal years 1989 and 1990, the Office of Transportation Systems has provided funding from the Technology Assessment and Transfer subprogram for the Argonne National Laboratory to conduct technical, economic, and institutional evaluations on the potential for MagLev transportation systems. Department representatives serve on both the MagLev Project Executive Committee and the Coordinating Committee for the interagency group coordinating MagLev activities.

Mr. Conte. Is there any money in the FY 1991 budget request for the Department of Energy that could be committed to MagLev R&D?

Admiral Watkins. Although the FY 1991 budget request for DOE does not include funding for MagLev R&D, it is expected that funding for the Department's involvement will come from interagency agreements with the U.S. Army Corps of Engineers and the Department of Transportation.

MAGNETIC FUSION ENERGY

Mr. Conte. The budget includes $325 million for the Department's magnetic fusion program. This is slightly above last year's appropriation but significantly below the FY 89 appropriation of $345 million. Briefly and generally describe the current state of fusion research in the U.S.

Admiral Watkins. Magnetic fusion research has been supported by the Department, and its predecessor agencies, for more than 30 years, and, with its present emphasis, since the mid-1970's. During this time, the program has made significant progress toward its goal, achieving near-breakeven conditions in experiments. The program has also undergone a major redirection to focus on understanding how tokamaks work, so that we can build the next experiment with confidence. At this time, the U.S. is engaged in an unprecedented international collaboration involving the world's four major fusion programs in the conceptual design of the International Thermonuclear Experimental Reactor. The strength of the U.S. program has been of crucial importance in making this collaboration a success. I think that now is the appropriate time to take a hard look at the fusion options and come up with a new strategy to develop fusion cost-effectively by early in the next century.

Mr. Conte. How would you assess the potential of this energy source for widespread commercial application in the twenty-first century?

Admiral Watkins. Fusion energy has the potential to provide electricity in the next century safely and without the creation of highly radioactive

waste products or greenhouse gases. The development of fusion is very important for the Nation's future. With a new strategy, clear milestones and good management, I believe we can develop fusion by 2025.

WIND ENERGY

Mr. Conte. The Department's budget request provides a $26 million increase for DOE Solar Energy programs. The budget, however, proposes a 6% reduction from the wind energy activity of the solar energy account. The Department acknowledges that, "Results to date ... show that there is significant opportunity for major advances in energy capture," from this proven energy source. Please explain why research into wind energy -- a proven source of clean and renewable energy -- is targeted for a cut when the account from which such research is funded is slated for a 25% increase.

Admiral Watkins. The increased funding is focused on a set of activities which we believe represent the highest potential payoff. Other core programs, such as wind energy, were maintained at approximately level budgets. Contracts with industry teams are being negotiated for advanced wind turbine conceptual design studies utilizing the additional funds the Congress appropriated over the Department's request in the FY 1990 budget. Funds are provided in our FY 1991 request for completion and evaluation of those design studies to ensure that such wind turbines would represent a major advance over the technology that exists commercially today. Assessing that potential advance will be a major factor in the development of our FY 1991 and future year wind energy strategy and budget requests.

ENERGY BIOSCIENCES

Mr. Conte. The FY 91 budget proposes a $447,000 reduction from the Department's Energy Biosciences program. This proposed reduction occurs at a time when the percentage of sound research proposals being funded by DOE is rapidly declining. It also occurs at a time when the budget proposes a 14% increase for Basic Energy Sciences programs. Isn't biosciences research particularly important now, in light of the fact that biomass will assume an increasingly important role in energy production in the coming century?

Admiral Watkins. In recent years we have experienced an escalation in operations costs of major national research facilities, such as the National Synchrotron Light Source (NSLS), for which Basic Energy Sciences has principal budgetary responsibility. As a result the research programs of Basic Energy Sciences have not received a proportionate funding increase. This does not mean that the Energy Biosciences program is viewed by DOE as of little importance or lacking in quality. Quite the contrary, the Energy Biosciences program is indeed one of the highest quality programs, and is attending to research needs in biology and biotechnology that no other agency is addressing. The DOE recognizes the critical role that biological systems have in energy production and will take this into account when we formulate research budgets for future years.

Mr. Conte. How many new research proposals were funded by this program in FY 89?

Admiral Watkins. In FY 89, nineteen new projects were initiated.

Mr. Conte. How many do you expect to be funded in FY 90?

Admiral Watkins. In FY 90 it is expected that either nine or ten new projects will be funded.

Mr. Conte. How many would be funded under the Department's request for FY 91?

Admiral Watkins. In FY 91, it is anticipated that four or five will be funded, assuming a normal turnover rate.

STATEMENT OF ADMIRAL JAMES D. WATKINS, USN (RETIRED)

SECRETARY OF ENERGY

FY 1991 APPROPRIATIONS HEARINGS

March 5, 1990

Mr. Chairman and members of the Committee, I am pleased to appear before you today to present an overview of the Department of Energy's FY 1991 budget request. This is the first budget prepared entirely by the Bush Administration, and it reflects new approaches in a number of technology areas as well as a new appreciation of the costs of past neglect.

Shortly after becoming Secretary of Energy just about a year ago I undertook an assessment of the Department which disclosed a number of serious problems requiring immediate attention. Two problems in particular are addressed directly in the FY 1991 budget I am presenting to you today. First, the Department had for many years emphasized production of nuclear materials and weapons without sufficient consideration for the environment. Our response has been the Environmental Restoration and Waste Management Five-Year Plan, which is strongly supported in the budget request. Second, it was apparent that the Department had no comprehensive, long-range strategy to bring coherence and focus to our energy technology programs. Consequently, at the President's direction, I initiated development of a National Energy Strategy (NES). While the NES is almost a year away from completion, the FY 1991 budget places higher priority on energy efficiency improvements and renewable

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technologies. This realignment of priorities is supported by the extensive public consultation process that the Department has been conducting since the summer of 1989 in conjunction with the development of the NES.

Other major themes which are reflected in the budget request include modernizing our defense facilities; reducing our dependence on imported oil; maintaining our scientific and technological competitiveness; and improving science and mathematics education.

Budget Overview

The FY 1991 budget request for the Department of Energy is $17.5 billion, an increase of 6.4 percent over the FY 1990 level. I would now like to highlight several of the more important programs and initiatives included in this budget. In doing so, I will group the programs into categories which correspond to our present understanding of the emerging NES, with modifications to permit discussion of the entire DOE budget, including those programs, such as defense and management oversight, which are not part of the NES.

Respecting the Environment

Managing facilities in an environmentally sound manner and restoring environmentally damaged sites are the highest priorities in the Department. Safe disposal of nuclear, hazardous, and mixed waste, and protecting worker and public health and safety are important objectives for the Department and for the Nation. The Environmental Restoration and Waste Management Five-Year

Plan is the cornerstone of the Department's long-term strategy to vigorously manage DOE's cleanup activities. The Five-Year Plan consolidates environmental restoration and waste management activities in the areas of Defense Programs, Nuclear Energy, and Energy Research, treats them as a unified program, and establishes a plan for compliance and cleanup with specific objectives against which progress will be measured. An Office of Environmental Restoration and Waste Management has been established to manage and direct Five-Year Plan activities.

The Five-Year Plan identifies three specific compliance-related activity areas. "Corrective Activities" are those necessary to bring facilities into compliance with applicable local, State, and federal regulations. "Environmental Restoration" includes the assessment and cleanup of surplus facilities and inactive sites. "Waste Management Operations" involve the treatment, storage, and disposal of wastes generated as a result of ongoing operations at active facilities. Development of new and improved technologies for waste minimization and cleanup will be undertaken to support the goals of each of these three areas.

The estimated cost identified by the Five-Year Plan is $19.0 billion for FY 1990-1995 for completing the highest priority activities (in addition to $0.7 billion for uranium enrichment cleanup). The $2.8 billion budget request for FY 1991, will fund activities necessary to prevent near-term adverse safety and environmental impacts and comply with existing compliance or cleanup agreements. This request will provide some additional funds for lower priority projects to reduce risks, promote compliance, reduce costs, and prevent disruption of the DOE mission.

Other related activities include the oversight functions of the Office of Environment, Safety and Health, defense waste transportation and site management, and the new Office of Nuclear Safety. These offices will oversee the implementation of DOE nuclear facility safety programs and continuously assess DOE and contractor nuclear safety performance.

The Nuclear Waste Fund is the other major element in the category referred to as "Respecting the Environment". In a November 1989 report to Congress, DOE pledged its best efforts toward meeting both near-term and long-term waste disposal milestones, consistent with its goals of safety and technical excellence. To achieve such goals, I announced the initiation of a "three-point" plan. The plan centers on restructuring the Office of Civilian Radioactive Waste Management, initiatives to gain access to the Yucca Mountain site to continue the scientific investigations needed to evaluate the site's suitability for a repository, and an initiative for establishing an integrated Monitored Retrievable Storage (MRS) facility to begin spent fuel acceptance in 1998. The FY 1991 Nuclear Waste Fund budget request of $292.8 million provides for continuation of the this three-point program.

Increasing Energy Efficiency and Securing Future Energy Supplies

This category includes conservation research and development and such energy supply technologies as solar and other renewables, nuclear, fossil, clean coal, and fusion. Also included are energy distribution programs such as the Power Marketing Administrations and our Electric Energy Systems and Energy Storage programs.

Energy conservation and efficiency improvements in homes, buildings, transportation and industry are essential to balancing energy supply and demand. The FY 1991 budget request for conservation research and development is more than twice the FY 1990 request, and reflects the new priority the Department is according energy conservation. These new priorities extend to solar and other renewable technologies. In FY 1991, our commitment to conservation and renewables research and development is reflected in the 8 percent budget increase over the FY 1990 appropriation, and the 78 percent increase over the FY 1990 request. Using energy more efficiently and developing cost-competitive renewable energy will contribute to both a better environment and to reduced U.S. oil imports.

The FY 1991 budget request is also in line with recently announced FY 1990 initiatives to increase energy efficiency and the use of renewable energy sources. These initiatives are intended to demonstrate what can be done to reduce production of so-called greenhouse gases and should result in energy savings which could exceed $32 billion, if the DOE and private sector efforts are considered together. The potential savings are many times the $336 million DOE plans to spend on these initiatives through the year 1995.

In nuclear energy, the budget supports development of advanced light water reactors (LWRs), including smaller (600 MWe) advanced LWRs with passive safety features, which can be built more quickly and cheaply and which better fit the incremental capacity needs of some utilities. The advanced reactor research and development program will continue to work on modular high temperature gas-cooled reactors (HTGRs) and advanced liquid metal reactors (ALMRs). The

HTGR has unique passive safety features and offers high quality process heat for industrial applications. The ALMR program will continue work on demonstrating the Integral Fuel Cycle (IFR) concept, where fuel is used in a reactor, reprocessed and recast into new fuel on site. An important new initiative will confirm the ability of an LMR, using the IFR concept, to burn up the long-lived waste products in spent commercial light water reactor fuel. If successful, it could greatly reduce the requirements for long-term storage of nuclear waste.

The FY 1991 budget assumes commencement of close out of the Fast Flux Test Reactor (FFTF) in April 1990, following Congressional approval. Operation of the FFTF costs about $100-$115 million per year. Its continued operation would require identification of a long-term mission, which is not apparent. We examined various missions, including Pu-238 production, but none of these were deemed to be a cost-effective use of the FFTF.

We continue to support legislation to create a government corporation to manage the Department's uranium enrichment enterprise. We believe it is the best way to meet aggressive foreign competition in enrichment services.

A revised policy for the fusion energy program is being drafted and will undergo an intensive review by an independent advisory panel in FY 1990. Reallocations may be required within the FY 1991 budget of $325 million when this review is complete.

In the fossil energy technology area, the total FY 1991 budget request for Clean Coal Technology, including advance appropriations enacted in prior

years, is $456 million. This will complete the funding for projects selected in Round 2 ($200 million) and Round 3 ($156 million), and will provide $100 million for the initial funding of Round 4 of the five-round program. The budget request also includes advance appropriations to become available in FY 1992-FY 1994 to fund the remainder of Round 4 and all of Round 5, which will complete funding for this major initiative. Industrial cost sharing in the 39 projects that are currently part of the Clean Coal Technology program has exceeded 60 percent.

The budget request for Fossil Energy Research and Development programs is almost 20 percent higher than the FY 1990 request. This request is based on the need to place federal spending in the context of fiscal constraints, and to focus expenditures on those projects which industry is unlikely to support without assistance. Improved liquid and gaseous fuels extraction technologies are essential to increase domestic oil and gas supplies. A major new item in our Fossil Energy Research and Development budget is a $17 million geoscience initiative to support a regional/reservoir research program that will be jcintly funded with consortia of States, industry and universities.

The President's budget proposes to make the Power Marketing Administrations (PMAs) operate in a more business-like manner. Legislation will be proposed to require the PMAs to make regular planned payments of unpaid principal on their federal debt by adopting straight-line amortization schedules and to pay market interest rates on the appropriation portion of the unpaid federal investment. Over the next five years these proposed reforms are expected to

produce over $4.6 billion in additional receipts to the Treasury. The budget also proposes the sale of Alaska Power and the sale of the Georgia-Alabama system of the Southeastern Power Administration.

Of particular significance in the Department's Electric Energy Systems program is the program in applied High Temperature Superconductivity (HTS). HTS holds the promise of fundamental efficiency improvements in electricity generation, transmission, distribution, and storage. The Department has actively developed superconductivity for over 20 years. The HTS Pilot Centers, proposed for a level of $15 million in FY 1991, are catalyzing government/industry partnerships in development of practical superconducting products, opening the door to a multi-billion dollar international market in the next decade.

Fortifying Foundations

Maintaining scientific and technological preeminence is key to this Nation's ability to compete in the increasingly competitive world economy. Our support for basic research and development in such areas as High Energy and Nuclear Physics, Basic Energy Sciences, Biological and Environmental Research, and construction of the Superconducting Super Collider is essential to our future prosperity.

The Department's budgets for science and technology programs in the "Fortifying Foundations" category show increases across all major program elements. In Nuclear Physics, funds are included to continue construction of the Continuous Electron Beam Accelerator Facility ($65 million) and to

initiate construction of the Relativistic Heavy Ion Collider ($15 million) in order to maintain our world leadership position in nuclear physics. In Basic Energy Sciences, two more powerful facilities currently under construction constitute a significant part of the FY 1991 budget request. Construction of the 1-2 GeV synchrotron radiation source at Lawrence Berkeley Laboratory will be largely completed with support provided in FY 1991 ($23 million), and construction support will continue for the 6-7 GeV synchrotron radiation source ($75 million) at Argonne National Laboratory.

Funding of $318 million is requested in FY 1991 for the Superconducting Super Collider (SSC), a proton-proton collider having an energy of 20 TeV per beam that will permit exploration of this new domain of physics research which cannot be reached by any other facility either in existence or planned. The SSC is a critical part of the Administration's initiative to strengthen the Nation's position as a world leader in science. Our support for the SSC does not mean diminished support for other, smaller, science projects. As mentioned above, all of the Department's major science programs are receiving increases in the FY 1991 request.

The most recent review by the SSC Laboratory has identified cost increases. Consequently, the project cost, scope and schedule are now under review. We plan to build the SSC to the full power level originally proposed, 20 TeV per beam, so we will be studying these cost issues very carefully. In a project of this size some cost escalation seems unavoidable, but the Administration's commitment to the project remains strong.

A program of major importance within Biological and Environmental Research is the human genome project. This is one of modern biology's most significant initiatives and will have enormous impacts in several areas, including the biomedical sciences, epidemiology, risk assessment, and the Nation's biotechnology industry. The Department is coordinating its activities in this area with the newly organized National Center for Human Genome Research of the National Institutes of Health. Our budget request in FY 1991 is $46 million.

Global climate change is another major area of research within the Biological and Environmental Research program. The Carbon Dioxide Research Program (CO_2) is the principal DOE activity in the U.S. Global Change National Research Program organized by the Committee on Earth Sciences of the Office of Science and Technology Policy (OSTP). The CO_2 program budget request is $65.9 million. The program provides the scientific underpinning for developing energy policies that address the climate change issue. The program has launched a major research initiative in global climate change, a major element being the Atmospheric Radiation Measurement (ARM) program. ARM will provide critical improvements to our understanding of the role of clouds and radiation in the climate models and will lead to better understanding of the magnitude, timing and regional effects of any global climate change.

One of the most serious educational problems facing the Nation is the declining number of young Americans, including women and minorities, pursuing careers in science and engineering. As a major employer of technically-proficient people, the Department has a major responsibility to ensure that the Nation's science education system is capable of meeting future requirements for manpower that can both extend the frontiers of science and

manage increasingly demanding technology. The FY 1991 budget request of $35 million for University and Science Education and the related University Research Instrumentation program, includes support for expanded pre-college science education initiatives developed at the Berkeley conference on mathematics and science education, and involves the Department's National Laboratories in local, State, regional, and national partnerships directed at improving pre-college science education.

Strengthening National Defense

The Department of Energy contributes to national security through its defense programs and through certain non-defense activities which assure the Nation's preparedness for potential energy emergencies. The budget for our defense programs, including Naval reactors, is $8.5 billion, up from $7.7 billion in FY 1990. Of this increased funding, $500 million is required in FY 1991 to continue the intensive efforts begun in FY 1990 on critical operations improvements throughout the defense complex, particularly at the Savannah River Site and the Rocky Flats Plant.

A significant change in our nuclear materials production program is the decision not to build the Special Isotope Separation (SIS) facility, and to bring this research and development program to an orderly conclusion, completing on-going experiments and documenting results. Other sources of plutonium are currently available, and Departmental priorities are changing. Consequently, the construction of additional plutonium production capacity as a contingency is not warranted.

By contrast, our need for a source of supply for tritium remains critically important. A substantial portion of the defense budget is for improvements to reactor hardware, procedures, training, management systems and practices and maintenance, so that we can resume reactor production of tritium as soon as improvements can be made to ensure safe and reliable operation of the Savannah River reactors. Looking to the future, the New Production Reactor program continues to pursue two preferred reactor technologies and sites for new tritium production capacity: a heavy water reactor at Savannah River and a modular high-temperature gas-cooled reactor at the Idaho National Engineering Laboratory. The FY 1991 budget request for New Production Reactors is $363 million.

The Department of Energy has a number of programs in place which serve to reduce the vulnerability of the U.S. to energy emergencies, such as energy supply disruptions, and foster international cooperation in global energy issues. Programs of this nature include the Naval Petroleum and Oil Shale Reserves (NPR), the Strategic Petroleum Reserve (SPR), and certain activities managed by the Office of International Affairs and Emergency Preparedness. The Administration proposes to lease both NPR-1 and NPR-3 at the earliest practicable date. Under this proposal the fields would be leased competitively, with competition to be expressed in terms of the royalty rate bidders would be willing to pay the Federal government after also paying a lease bonus of $1.6 billion, $1 billion of which would be paid at the end of FY 1991. To ensure that the Department of Defense has a secure source of oil after NPR-1 is leased, the proposal provides for the creation of a 10 million barrel Defense Petroleum Inventory (DPI) to be stored in a cavern at the Strategic Petroleum Reserve (SPR), and filling it with oil over a five-year

period beginning in FY 1992. The DPI cavern and oil fill will be funded from NPR lease royalty payments.

This proposal enhances energy security and defense preparedness and reduces the FY 1991 deficit by $1 billion. Draft legislation to permit and authorize the proposed leasing arrangement will be transmitted to the Congress shortly.

The FY 1991 budget request proposes the continued development of the SPR on a schedule to achieve the full 750 million barrels of storage capacity by the end of FY 1991 (capable of fill by the end of FY 1992), and the continued implementation of the ongoing program to increase drawdown capability to 4.5 million barrels per day. The budget also proposes to fill the SPR at a rate of approximately 59,000 barrels a day in FY 1991.

The legislation authorizing the SPR program expires in April 1990. The Department is preparing recommendations to extend the statutory authority and to increase the Department's drawdown flexibility in the event of a Presidential determination to use the Reserve during a supply disruption. A study mandated by Congress in 1989, on alternative methods of financing the SPR, was completed by the Department and transmitted to Congress on February 2. As a result of this study, the Department intends to seek discretionary authority to enter into negotiations with one or more major petroleum producers on a leasing arrangement for SPR oil. Under an oil "lease" or "option" concept, the Federal government would obtain control over the oil in the SPR, but without necessarily bearing the full cost of outright purchase. Our intention would be to implement these authorities within available budget resources, as set forth in the President's FY 1991 budget.

At the request of the President, DOE also carried out an interagency study of SPR size. The results of this study, transmitted to Congress on February 2 concurrently with the financing alternatives report, are that a 750 million barrel SPR will provide the U.S. with substantial protection against reasonably foreseeable future disruptions. These conclusions were reached after a comprehensive review of economic, foreign policy, energy security, and strategic considerations by a policy level steering group comprised of representatives of all federal departments and agencies with interest in the SPR.

Management and Other Activities

The remainder of the Department's missions include conservation grants, energy information, regulation, and management and administrative functions. Most of the programs in this category are relatively unchanged from last year. The major exception is the Conservation Grants program. We believe that in view of the substantial resources made available to these programs from oil overcharge funds distributed to the States, there is currently no need to provide direct federal grants. Instead, we are proposing incentive funding for the States through the Weatherization Assistance Program. A total of $15 million is requested for two initiatives; $5 million to stimulate innovative programmatic approaches and $10 million to leverage non-governmental funding resources. Another $15 million is being requested for oversight and monitoring of State use of oil overcharge funds. It is

expected that the funding requirements will be offset by funds from the Petroleum Overcharge Distribution and Restitution Act (PODRA) declared excess by the Office of Hearings and Appeals.

Staffing

Many of the Department's most important programs have been adversely affected by difficulties in attracting highly qualified people, particularly in critical areas such as environment, safety, defense, research, and contract management. DOE is working closely with the Office of Personnel Management to develop legislation on a government-wide basis to establish a special salary structure for a limited number of very critical technical positions and to exempt a number of technical positions from the strictures of the "dual compensation" laws so that we might attract some highly qualified individuals to civilian federal service. Obtaining enactment of this legislation is a very high priority for the Department.

Mr. Chairman, I believe the Department of Energy's FY 1991 budget request is sound and strongly supports our energy, science, and defense missions with a proper regard for the environment and for the health and safety of our workers and the citizens of the United States. I look forward to working with the Congress to achieve these objectives.

WEDNESDAY, MARCH 7, 1990.

GENERAL SCIENCE, BASIC ENERGY SCIENCES, SUPPORTING RESEARCH AND TECHNICAL ANALYSIS, BIOLOGICAL AND ENVIRONMENTAL RESEARCH, FUSION

WITNESS

DR. JAMES F. DECKER, ACTING DIRECTOR, OFFICE OF ENERGY RESEARCH

Mr. Bevill.

Dr. Decker, we're again glad to have you with us, and we'd be glad to hear from you. You may proceed as you wish.

Dr. DECKER. Thank you.

Mr. Chairman, members of the subcommittee, it's a pleasure for me to appear before you today to discuss the Department of Energy's Fiscal Year 1991 Budget Request for the programs of the Office of Energy Research.

ENERGY RESEARCH BUDGET

These programs include High Energy Physics, the Superconducting Super Collider, Nuclear Physics, Basic Energy Sciences, Biological and Environmental research, Magnetic Fusion Energy, University and Science Education and supporting programs.

The total Fiscal Year 1991 Budget Request for these activities is $2.7 billion, an increase of about $302 million over the Fiscal Year 1990 appropriation.

This request reflects the Administration's strong belief in the key role played by science in our Nation's future technological and economic well being.

The benefits to society from its support of basic research in science transcends conventional market analysis. In fact, the 1987 Nobel Prize in Economics was awarded to Robert Solow for his early work showing that economic growth comes from new technology.

Of course, it's well established that technological progress is derived from advances in basic research. The research activities that we are discussing today are a very significant and important part of the Government's basic research programs.

I'd like to take the next few minutes to highlight some key aspects of the energy research programs for Fiscal Year 1991.

HIGH ENERGY PHYSICS

First, High Energy Physics. During the past year, SLAC and Fermilab have measured certain key features of the so-called standard model.

While incomplete, this model describes the fundamental particles and forces and has been successfully used to predict what pieces are missing.

Precise determination of the mass and lifetime of the Z particle that carries the weak nuclear force were made this year.

The measurements have confirmed the prediction of the model by setting limits on the number of different species of particles.

The search for the elusive top quark predicted by the standard model continues at Fermilab, and a lower limit on its mass was established at 78 billion electron volts.

Higher energies required to continue this search are only available at Fermilab. The Fiscal Year 1991 Budget Request provides for full operation of our high energy physics facilities at Fermilab, SLAC and Brookhaven to fully exploit the research capabilities at those laboratories.

SUPERCONDUCTING SUPER COLLIDER

Next, I'll turn to the Superconducting Super Collider. There are a number of important fundamental questions about the standard model that can't be answered using our present facilities, either here or abroad.

For example, the standard model does not account for the mass of particles, a very fundamental property. Are quarks and leptons really fundamental particles? Are there additional forces beyond the four that we know today?

To reach the energy necessary to try to get answers to these questions, we need to build the SSC. Since Secretary Watkins testified before you on Monday, and there was considerable discussion about the SCC, I'll only hit some of the highlights in that program.

During the last year, substantial progress was made on the SSC. In January of last year, the Department contracted with the University Research Association to design, construct and operate the SSC.

Just 12 months ago, we began creating the SSC laboratory from a true greenfield start. One of the first tasks of this new laboratory has been to complete a new baseline conceptual design for the Texas site.

You may recall that the original conceptual design was completed in 1986. That design was developed by a national design team that was located at the Lawrence Berkeley Laboratory.

The preliminary baseline design completed in January of this year contains two important technical design changes based on new information that has been learned since the original 1986 design was completed.

First, the injector which sends protons into the main 54-mile ring had to be enlarged to inject protons at two trillion rather than one trillion electron volts, and also the magnet aperture had to be increased from four centimeters to five centimeters.

These technical design changes, which became clear only this fall, have led to significant increases in the estimated cost of the project.

There are some additional cost increases due to different and more accurate estimates of labor rates and some other things.

The total cost increase projected by the SSC laboratory is between $1 billion and $2 billion above the $5.9 billion that we talked to you about last year.

About two-thirds of this increase is due to the technical design changes. Over the next few months, the laboratory will continue to refine this design and associated schedule estimates.

The Department will conduct two independent reviews of the laboratory's work and will have a new validated cost estimate sometime this summer.

In Fiscal Year 1991, the primary emphasis in the project will be on design and magnet development. Let me turn now to nuclear physics.

NUCLEAR PHYSICS

The Nuclear Physics Program seeks to understand the behavior and structure of the nucleus. While there are many important activities, I will mention only two; the proposed Relativistic Heavy Ion Collider at Brookhaven, and the Continuous Electron Beam Accelerator Facility being constructed at Newport News, Virginia.

We are requesting $15 million to start construction of the Relativistic Heavy Ion Collider, known as RHIC. When RHIC is operational, it will be possible, for the first time, to study nuclear matter at extreme conditions of temperature and density.

At these extreme conditions, a new state of nuclear matter, a quark-gluon plasma, can be studied for the very first time.

CEBAF, for which we are requesting $65 million in Fiscal Year 1991, uses continuous beams of electrons to probe nuclei to carry out a broad range of detailed measurements of the location and motion of elementary particles embedded in nuclear matter. CEBAF will be completed in Fiscal Year 1993.

BASIC ENERGY SCIENCES

I'd next like to turn briefly to Basic Energy Sciences. In addition to supporting research over a wide range of technical areas, the Basic Energy Sciences Program funds the operation of major facilities, such as synchrotron radiation sources, neutron sources, and the combustion research facility, which are used very extensively by both industrial and university researchers.

I'd like to mention briefly two major synchrotron light source construction projects that are underway. The one to two GeV synchrotron project at the Lawrence Berkeley Laboratory is a third-generation light source in the vacuum ultraviolet soft X-ray range. Construction started in Fiscal Year 1987.

This facility will permit new studies in both basic and applied science, using unique capabilities of its beams, high brilliance and very short pulse lengths.

We are requesting $23 million in the Fiscal Year 1991 budget and expect to complete this project in Fiscal Year 1993.

For the other project, the six to seven GeV hard X-ray light source at Argonne, we are requesting $75 million to continue construction which just started in Fiscal Year 1990.

This third-generation facility will provide brilliant X- ray beams that are really unavailable anywhere else in the world and will contribute to many, many different areas of research.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

Next, I want to say a little bit about the Biological and Environmental Research Program. The Department takes very seriously its responsibility to identify, understand and anticipate the long term health and environmental consequences of energy development and use.

The Biological and Environmental Research Program conducts research to try to understand these affects. Today, I'd like to highlight just three elements of our Fiscal Year 1991 program; epidemiologic research, the human genome program, and global climate change.

In response to the need to organize and integrate epidemiologic data from DOE contractor worker studies, the Fiscal Year 1991 request includes continued development of something called the Comprehensive Epidemiologic Data Resource, which is one element of the Secretary's four-point epidemiologic initiative.

The data in this repository will be made available to all qualified researchers for epidemiologic studies. That is, those that are both funded by the Department of Energy and those that may be funded from other sources.

The Human Genome Program, which is carried out jointly with the National Institutes of Health, is aimed at characterizing the genetic material in the human cell and is the first large scale program in the biological sciences.

The Department's portion of the program for which we are requesting an increase of $19.9 million in Fiscal Year 1991 focuses on developing analytical and computational resources to develop better ways to physically manipulate large fragments of DNA.

The National Institutes of Health effort is oriented toward characterizing disease oriented genes through use of both human and non-human model systems.

The issue of global climate change must be an important component of national energy strategy. Our Carbon Dioxide Research Program is the principal Department activity in the U.S. Global Change Research Program coordinated by the Office of Science and Technology Policy in the White House.

With the Fiscal Year 1990 appropriation, we have launched a major research initiative to provide the scientific underpinning for prediction of global and regional climate change.

The principal component is an experimental program to quantify cloud formation processes and the roles of clouds in climate change.

This is a major uncertainty in present climate models. In Fiscal Year 1991, we are requesting an increase of $15.8 million for these global change activities.

MAGNETIC FUSION

I'll turn next to magnetic fusion. Fusion promises to be an attractive source of energy for several reasons; fuel availability, low radioactive waste, and safety.

I'm encouraged by recent progress in fusion research, both here in the United States and abroad. The conditions required for energy break-even have nearly been achieved in TFTR and the JET experiment in Europe has come even closer.

Another important result is demonstration that the pressure required for a reactor could be obtained in the magnetic field of a Tokomak, and that was achieved at the Doublet III device at General Atomics.

Working collaboratively, the United States, Europe, Japan, and the Soviet Union recently completed an interim conceptual design report for an engineering test reactor, called the International Thermonuclear Experimental Reactor, better known as ITER.

Taken together, I think these accomplishments and others described in my written statement indicate that there has been significant progress made on fusion energy.

Given the potential importance of fusion energy for meeting the Nation's energy needs for the future, Secretary Watkins felt that it was prudent to review our development strategy.

The Secretary has formed an independent Fusion Policy Advisory Committee to carry out a high level review of fusion over the next few months.

This review will recommend to the Department a fusion policy for both magnetic and inertial confinement programs. The review will be completed in September, and we will carefully consider this committee's recommendations.

For Fiscal Year 1991, it's my intention to maintain the current Magnetic Fusion Program balance with a focus on confinement physics which was started last year.

When the review is completed in September, our program plans and budget estimates will be revised as appropriate.

I'd like to complete my oral remarks by mentioning our strong commitment for science education. We will continue to use the unique resources of our National laboratories to expose both teachers and students to the excitement of frontier research.

Our primary emphasis is shifting to focus more of our activities on precollege and women and minorities, where there is a real crisis in the Nation.

Secretary Watkins spoke about that on Monday. We are simply losing too many students from science and math at a very early age.

That completes my remarks, and I'd be glad to answer any questions.

[The prepared statement of Dr. Decker appears at the end of the hearing record:]

SSC FOREIGN CONTRIBUTIONS

Mr. BEVILL. Dr. Decker, what is the status of the commitment of foreign funds to the SSC project? Exactly what countries have agreed to provide what funds?

Dr. DECKER. Mr. Chairman, we, during the last year, have put together an international plan for participation of other countries in the SSC.

We had done this in concert with a number of other agencies in the Executive Branch. We have not moved forward in an aggressive way to implement that plan because we had these uncertainties in the scope and the cost of the project.

I think we are getting those issues worked through right now, and I would expect that we would be moving out fairly aggressively after appropriate consultations with Congress.

We would be moving out aggressively to talk to other countries again. Of course, we did have some contact with other countries back a couple of years ago, and I would expect to move forward with some fairly high level negotiations, going to other countries, in the very near future.

We have only one real commitment at this point, and that's $50 million from India, but we are certainly optimistic about getting some significant contributions from other countries.

Mr. BEVILL. It seems we're losing ground on foreign commitments. As I recall, a couple of years ago, then-Secretary of Energy testified that Japan would probably commit to a billion dollars, that Italy and Germany would participate, and then Secretary Watkins advises us of only one $50 million commitment.

It looks like we're losing ground. You've mentioned one country, I believe, so we're not making much progress on that, are we?

Dr. DECKER. We haven't made as much progress as I would have liked to have made by this time. I think the most progress that we have made is at least to get agreement within the Executive Branch as to how we should approach international participation in the Super Collider.

As I say, our discussions with other countries were put on hold for a while until we resolve this issue of the scope of the project and its cost.

SSC COST

Mr. BEVILL. The cost started off, as I recall, at $4.4 billion, and then went to $5.9 billion. Now it is $1 billion to $2 billion more because of the changes in the design. I understand that this is because of improvements on the original design. Nobody anticipated improvements on the original design last year, less than a year ago.

Now, we have had two increases, and the explanation for the first increase was inflation I believe.

We are getting nervous hearing testimony on the biggest project ever undertaken in the world of this type, and hearing that the price has gone up twice. We hear that the costs have gone up $1 billion and $2 billion. I hope you can appreciate where that leaves us.

We're being asked to appropriate a project that is skyrocketing in cost and going backwards as far as any foreign participation is concerned.

I hope that you can concentrate on this and get us out of this dilemma. You know, this panel is very supportive of the project, but we are concerned and we're getting more concerned about the cost.

Dr. DECKER. We are very concerned about the cost, as well. First, let me comment on the numbers. I believe the original $4.4 billion was in 1988 dollars, and then escalating that and turning it into as-spent dollars leads to $5.9 billion.

What we ran into in the last year is the necessity of making two technical design changes in the project so that we could be sure that, in fact, the accelerator would work when it was turned on and we could get it to work in a reasonable amount of time.

Those technical design changes are really based on information that we learned from the operation of Tevatron, which is the first superconducting accelerator, and also information that was learned from building the superconducting accelerator in Germany, called HERA.

What we learned is that there are some properties of superconducting magnets, called persistent currents, that we had not appreciated before, and those persistent currents cause adverse effects on the quality of the magnetic field.

To overcome that particular effect, we felt that it was essential to increase the injection energy from one trillion to two trillion electron volts, and also to increase the aperture of the magnets from four centimeters to five centimeters.

But, unfortunately, those are expensive changes. We share your concern about the cost, that's for sure.

Mr. BEVILL. Well, I hope you can get things under control and find out what this project is going to cost and how many countries are going to participate.

That's what we need to know. We're trying to be helpful, but we're having problems, and we're going to be looking at you and the Secretary, of course, to come up with the answers to those questions.

RELATIVISTIC HEAVY ION COLLIDER

Would you please provide the justification for starting construction of the 400 million relativistic heavy ion collider during this period of significant physical restraint?

Dr. DECKER. The relativistic heavy ion collider is designed to look at a whole new area of nuclear physics. It is designed to take massive nuclei, collide them, and create a state of nuclear matter which is at a very high temperature and a very high density, and that is a whole new state of matter which has never been examined before.

In these very high temperature, high density conditions, one forms a state of matter called a quark-gluon plasma. It is a state of matter which we believe existed shortly after the Big Bang, and I think it will be extremely exciting to see how that particular state of matter behaves, how matter that we know today, neutrons, protons and so forth, condense out of that particular state. I think it's a very exciting area of physics.

MAGNETIC FUSION

Mr. BEVILL. Last year, the Department proposed a significant restructuring of the magnetic fusion program. Would you describe

how that restructuring is being continued or changed in Fiscal Year 1991?

Dr. DECKER. What we did in the way of changing directions in the program last year was to try to put more emphasis on understanding the energy loss mechanisms from Tokomaks.

That's a very important physics question, one that becomes very important as we move closer toward building fusion reactors, building larger machines.

We are continuing that emphasis in the program in Fiscal Year 1991. We are not doing any other restructuring of the program really pending the outcome of this Fusion Policy Advisory Committee review, the results of which we will get this summer.

We would hope to have some sort of an interim report from this committee in July and the final report in September, but since the committee has not yet met for the first time, maybe I'm going out on a limb a bit in predicting when they'll have a report for us.

Mr. BEVILL. I'm sorry, I didn't hear when you predict you would have a report.

Dr. DECKER. The final report we expect in September. Actually, the committee is slated to go out of existence, I think, on September 30th.

Mr. BEVILL. As you know, Dr. Decker, this is another program that we're becoming more and more concerned about the cost. How many billion have we put into this program?

Dr. DECKER. I don't know the answer to that offhand.

Mr. BEVILL. Would you furnish that for the record? We'd like to know how much we've already invested, how long the program has been going on, and your best estimate of when we're going to see some results.

Dr. DECKER. I'd be glad to furnish that information for the record.

[The information follows:]

MAGNETIC FUSION ENERGY

Through FY 1989, a total of about $5.8 billion had been spent on Magnetic Fusion Energy research over about a 35-year period. For reference, the ERDA prepared 1976 Fusion Power by Magnetic Confinement Program Plan, identified a total estimated cost for developing fusion through the operation of a demo-plant of about $20 billion in 1978 dollars. The program has done very well with the funds available. Great progress has been made towards understanding how fusion reactions can be controlled and used to produce energy. The Tokamak Fusion Test Reactor at Princeton Plasma Physics Laboratory recently achieved conditions within a factor of two of what would be required for breakeven using deuterium-tritium fuel. Using techniques developed in collaboration with the U.S., the European Community's Joint European Torus (JET) has recently extended the TFTR results to 0.8 of breakeven (breakeven condition is where the power produced by fusion of deuterium-tritium would equal the amount of external energy required to heat the plasma). While many factors may affect the schedule for commercial availability of fusion, it is generally felt that it could be available as early as 2025.

Mr. BEVILL. Congressman Myers was making the point when Secretary Watkins was testifying how difficult it is to justify these programs when you pour billions into them and then we see no results.

I'm not saying that there's not any, but I am concerned that the testimony does not justify the billions we have put into the program. We are getting very concerned about the cost.

Dr. DECKER. I think that there has been good progress. It is a very difficult technological problem. It is one of the most difficult that we've ever undertaken.

This year, we did have some real progress in getting closer to break-even conditions, we've had some very impressive results in the JET device in Europe.

I think that the measure of getting close to break-even is something called Q, which is a ratio of the energy out, if you had a tritium plasma divided by the amount of energy that was put into the plasma to heat it up, and that number is now up to .8. Break-even would be one, so it's very close.

We've also had some very good progress in being able to reach plasma pressures in a Tokamak that are close to what one needs in a reactor.

Those are all very important bits of progress. I think they're hard to explain, and it's hard to realize how important those results really are, but it is a very expensive development program, without a doubt, and we will reach the point where, in order to make additional progress, we clearly are going to need more expensive facilities.

Mr. BEVILL. Since the Energy Department was created, that would have been 13 or 14 years ago, we've been told that we are going to be seeing some real results in this field within 25 years. We are all aware that research is not an exact science, but I recently heard that we ought to have a break through within 25 years. You see how far we're getting on that program.

You have all the expertise there in the Department of Energy, and we rely heavily on you. We checked back just to see what we had done on some of these programs recommended by your Department, and in five years, we had discontinued programs in which we had invested $6 billion.

Putting it another way, we spent $6 billion with nothing to show. The project down in Tennessee, Clinch River, we do have a hole in the ground down there. That's all we have to show for all that $6 billion.

Two things. A hole in the ground and memory. We are getting concerned about some of the advice we're getting and the recommendations we're getting.

Frankly, the U.S. Department of Energy's track record is not too good. I hope the changes you all are making will result in a better organization.

I don't think it's going to hurt anything, and it might help.

The Chair recognizes Mr. Myers.

Mr. MYERS. Thank you, Mr. Chairman.

Dr. Decker, I guess all of us are interested in research. Yesterday in another subcommittee, I commented that in agriculture, if we only had a million dollars to invest, I think I would invest it in research.

Not all the things that we do produce results. But at the same time we have to go back to the voters and justify how we spent their money. Sometimes we forget it's their money we spend.

So we rely upon you to come forth with a product and show the accomplishment of what you discover, whether it be a quark or a Z

particle or whatever, show how the taxpayer can benefit from the research.

I'm not going to belabor that any further. I remember about eight or ten years ago in this committee. I was critical of science just for science's sake. Just to keep somebody working isn't the goal that we should have as a committee or as a Nation.

I've got a lot of critical mail from around the country, including my own university, Purdue. Some researchers said who am I just a layman? What right do you have to question the work we're doing?

Well, the reason is we're paying for it. I'm a taxpayer like everyone else, and we represent those taxpayers.

We do need to have input from you. If we seem critical sometimes I think you probably understand. Some of your predecessors haven't always understood.

SSC "IN KIND" CONTRIBUTIONS

With regard to the SSC, I was alarmed as I looked back at what was said the other day. I believe the Secretary made the comment that the non-Federal investment would be "in kind".

Could you explain what that is? What is "in kind" contributions?

What is the in kind that he was speaking of? Can you enlighten us?

Dr. DECKER. Yes, let me try to explain that. In seeking foreign contributions to the project and discussing those possibilities with other countries, it seems like the best possibility is that those countries will wish to supply components to the project rather than cash.

It's much easier for them to appropriate money in their countries and have their own industry build something which they then ship to us to incorporate in the project, and that's really what we're referring to when we talk about in kind contributions to the project.

Or it might be that they send staff over free of charge to help us.

Mr. MYERS. Other than the Secretary, who in the Department will be charged with the responsibility of bringing on board these investors, be they foreign or domestic?

Are any universities going to provide in kind or help with the construction? Who will be in charge?

Dr. DECKER. The State of Texas is putting up a billion dollars.

Mr. MYERS. But there's no formal agreement. There's just a commitment, but no formal agreement. Am I correct on that?

Dr. DECKER. Well, we're working toward a formal agreement with Texas, and I would expect that we would complete that sometime this spring.

With regard to who is in charge of bringing in the foreign commitments, I think that responsibility falls with me, it falls with the Secretary for International Affairs, John Easton, Henson Moore will certainly play a role, the Deputy Secretary, there are a number of us who are working that problem.

Mr. MYERS. Will it be written in a way that it will obligate future administrations in Texas? What we've experienced here is a new administration comes in and says that wasn't on our watch. We're reneging on that agreement.

We spoke about the Breeder reactor we were building which was going very well, then Jimmy Carter got elected, and it all fell in.

I'm not being political here. A new administration came in and changed the commitment. That has happened with both Democrats and Republicans. Will we be sure of future administration in Texas?

Dr. DECKER. The Texas money is being raised through the issuing of bonds, and I think there will be a couple of bond issues which will total this one billion dollars.

I don't think that there is a political tie to the administration——

Mr. MYERS. Not today.

Dr. DECKER. But I think the intent is for them to go out to issue the bonds relatively soon.

Mr. MYERS. Well, this committee has supported the project but we have had some questions, some reservations. The full committee has even more serious reservations.

SYNCHROTRON LIGHT SOURCES

You spoke about CEBAF, and also you spoke about the two and six GeV synchrotron.

Do we need both of them? What will the six to seven do that we couldn't get on a smaller scale from the one to two GeV machine?

Dr. DECKER. That's a good question. The two light sources operate in different ranges of wavelength. The one to two GeV operates in a wavelength range of the vacuum ultraviolet into the soft X-ray, and the properties of that radiation are very good for looking at surface phenomena.

Also, it puts out very short pulses and is very good for looking at chemical kinetics. The six to seven GeV puts out radiation in the hard X-ray regime, which means it's a much more penetrating radiation that can look inside matter, and it is good for things like angiography.

Mr. MYERS. We're not scientists, if you can kind of talk in cow pasture language we can understand.

Through the years, we begin to understand but sometimes something comes along to throw us a curve.

Dr. DECKER. All right.

Mr. MYERS. You said the larger machine will explore areas that the smaller one can't.

Dr. DECKER. Yes.

Mr. MYERS. Do we need the smaller one then?

Dr. DECKER. Yes, because the one to two is very important for looking at surface phenomena, its radiation output is in very short pulses, which means that it is well suited for looking at chemical dynamics.

We can see how compounds and so forth form in very short time frames. Perhaps I need to provide you with a better explanation for the record.

Mr. MYERS. Okay, if you would, please.

[The information follows:]

COMPARISON OF THE 1-2 GEV WITH THE 6-7 GEV

The 1-2 GeV Synchrotron Radiation Source at Lawrence Berkeley Laboratory will be a lower energy machine and, hence, will produce lower energy radiation than the 6-7 GeV synchrotron Argonne machine, in the spectral region of ultraviolet radiation to soft x-ray radiation. The 6-7 GeV Synchrotron Radiation Source will be a higher energy machine and will produce hard x-rays. The corresponding wavelengths will be longer at the Berkeley machine than at the Argonne machine. At Argonne, angiography experiments to detect coronary artery restrictions in humans will be possible, as well as structure determinations of compounds and catalysts. At Berkeley, surface studies and chemical dynamics studies will be possible, as well as experiments on x-ray lithography. One of the earliest studies which reviewed the need for a new high brilliance synchrotron radiation source examined the possiblity of designing one machine to cover the entire spectrum from ultraviolet to hard x-radiation, and concluded it was not possible. That is whey every country that has reviewed the situation has also concluded that each machine can only be optimized for a portion of the spectrum needed, hence, the requirement to construct two light sources.

NUCLEAR MEDICINE

Mr. MYERS. You mentioned the six/seven GeV would have some medical application. Did I miss your nuclear medicine research?

Dr. DECKER. I did not specifically mention it.

Mr. MYERS. What is being done in nuclear medicine? What's the story on your budget? I think last year, you had $36 million.

Dr. DECKER. Yes, I think that budget is roughly constant. Yes, I think it goes from $32.2 million to $34 million.

I'm sorry, that's not quite right.

Mr. MYERS. I thought it was more.

Dr. DECKER. It's constant at about $37 million.

Mr. MYERS. Constant. With inflation, then, we're really spending less money on it. Are we spending enough money on nuclear medical research?

Dr. DECKER. I think that——

Mr. MYERS. How much did you request when it went to OMB?

Dr. DECKER. I think it's the same number, but I'm not positive.

Mr. MYERS. Mrs. Boggs has an interest in this area, too. I'll try not to get in too much, because she is more of an expert.

I have a recent interest, she has a long standing interest.

I recall Dr. Hunter, last year, speaking about the research being done not only in cancer, but in diagnostic work, as well as treatment.

Are we continuing research in these areas?

Dr. DECKER. Yes, we are. I think we have a very vigorous program and a very good program. We have cut back in one area.

We did have some money going toward fairly quick clinical trials of boron-neutron capture therapy, and all of the scientific reviews have suggested that we should not be moving that quickly toward clinical trials, that we need to do more basic research, we need to find better boron compounds that are absorbed very efficiently into tumors in the brain.

The whole essence of the boron-neutron therapy program is aimed at trying to provide some sort of a treatment for certain types of brain tumors.

We need to do this longer range research to find better boron compounds before we can move toward these clinical trials, so we

have cut back on that work that was aimed toward the clinical trials.

The rest of the nuclear medicine program has roughly a cost of living increase.

Mr. MYERS. Will we keep people working in those areas of research with only a cost of living increase? The experienced people. Are you going to lose scientists and doctors?

Dr. DECKER. I guess I don't know that for sure. I believe that we will not lose people, but I don't know for sure.

PETT PROGRAM

Mr. MYERS. Dr. Hunter spoke last year about the PETT Program. Is that the one you're speaking of?

Dr. DECKER. That's part of it. That's a very exciting program. It has produced some really interesting results. It is the one diagnostic that we have that can really look at the functioning of the brain and the heart.

For example, one can see how if a monkey ingests cocaine that the cocaine will, you know, concentrate in certain areas of the brain and in certain areas of the heart.

One can look at the damage that it can do to the brain and to the heart, see how that damage repairs, maybe one day we'll even define chemicals that could counteract cocaine.

Mr. MYERS. You spoke about the boron tests. I read about research in bone cancer. I believe, they take the marrow out, treat it, and then put the bone marrow back in.

Are you familiar with that experimentation?

Dr. DECKER. I've heard about that work, but it's not something that we're involved with.

Mr. MYERS. Is that similar to the boron tests that you were running?

Dr. DECKER. No, I think that's a different matter, unless it's something I'm just not familiar with.

Mr. MYERS. Well, again, I was reading what Dr. Hunter had to say last year. I believe he talked about a pharmaceutical copper 67 compound being used to identify lymph cancer. Do you know what's happening on that program?

Dr. DECKER. I could maybe ask Dr. Robert Wood to address that.

Dr. WOOD. I'm sorry, I can't give you the specifics. Copper 67 is a radioactive material.

It's quite a different approach than the boron capture therapy that Dr. Decker is talking about.

Mr. MYERS. Well, that's treatment, isn't it? And this is diagnostic, I think.

Dr. WOOD. Copper 67 would be a diagnostic approach to try to identify the location of a particular tumor.

Mr. MYERS. Would you provide it for the record?

Dr. WOOD. Yes, certainly. We'd be glad to bring you an up-to-date statement.

[The information follows:]

INFORMATION ON COPPER 67 RESEARCH/USE FOR LYMPH CANCER TREATMENT AND BORON TREATMENT ON BONE MARROW

One objective of Department of Energy research is to develop imaging agents, such as copper-67 labeled porphyrins, to detect inflamed and neoplastic lymph nodes and inflammatory lesions causing fever of unknown origin. The ability to image diseased lymph nodes is important in order to detect nodal involvement in metastatic cancer and in lymphatic tumors, to establish the stage of cancer, to determine cancer therapy modalities, and to determine the physical extent of infections. A diagnostic imaging agent for inflammatory lesions would locate abscesses, thus aiding in their treatment.

Current research on the development of boron compounds is limited to those suitable for the treatment of glioblastoma and melanoma by a technique termed Boron Neutron Capture Therapy. Currently, the Department of Energy does not support any boron treatment research on bone marrow.

Mr. MYERS. I have some other questions, but I've used 15 minutes, so if we have time, I'll get back to them. In respect to the other members, I'll yield time. Thank you.

Mr. BEVILL. The Chair recognizes Mrs. Boggs.

Mrs. BOGGS. Thank you, Mr. Chairman.

Dr. Decker, welcome, and thank you so much for your remarkable testimony. Your knowledge and your willingness to share it with us is really phenomenal.

UNIVERSITY RESEARCH

The Department supports a wide range of university research activities, both directly and indirectly. Does the Department have any information on the geographic spread of the research support? If not, could that be developed for the record?

Dr. DECKER. Yes. We do have that information, and I'd be glad to provide it for you.

[The information follows:]

ZRP4C
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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

01/08/90
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PAGE NUMBER		FY 1990 ESTIMATE	FY 1991 ESTIMATE
1	ALABAMA	1,483	1,284
2	ALASKA	458	485
3	ARIZONA	2,778	2,619
4	CALIFORNIA	491,008	510,809
5	COLORADO	8,694	8,950
6	CONNECTICUT	9,325	10,681
7	DELAWARE	755	760
8	DISTRICT OF COLUMBIA	88,478	102,511
9	FLORIDA	16,455	5,260
10	GEORGIA	5,660	6,421
11	HAWAII	1,660	1,654
12	IDAHO	13,981	10,590
13	ILLINOIS	377,326	438,589
14	INDIANA	11,340	11,302
15	IOWA	19,581	20,408
16	KANSAS	2,127	2,204
17	KENTUCKY	538	550
18	LOUISIANA	11,363	1,564
19	MAINE	127	130
20	MARYLAND	11,646	11,175
21	MASSACHUSETTS	71,169	70,781
22	MICHIGAN	10,826	10,402
23	MINNESOTA	4,896	4,999
24	MISSISSIPPI	907	911
25	MISSOURI	2,538	3,043
26	MONTANA	42	42
27	NEBRASKA	338	360
28	NEVADA	93	93
29	NEW HAMPSHIRE	908	821
30	NEW JERSEY	91,404	93,792
31	NEW MEXICO	155,819	140,594
32	NEW YORK	239,079	269,817
33	NORTH CAROLINA	6,041	6,211
34	OHIO	5,887	5,669
35	OKLAHOMA	1,731	1,596
36	OREGON	12,119	2,277
37	PENNSYLVANIA	13,704	13,274
38	PUERTO RICO	100	75

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

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PAGE NUMBER		FY 1990 ESTIMATE	FY 1991 ESTIMATE
39	RHODE ISLAND	3,437	2,641
40	SOUTH CAROLINA	1,422	1,715
41	SOUTH DAKOTA	100	100
42	TENNESSEE	173,397	186,100
43	TEXAS	218,340	322,108
44	UTAH	3,665	3,790
45	VERMONT	465	335
46	VIRGINIA	86,954	97,413
47	WASHINGTON	50,458	54,059
48	WEST VIRGINIA	201	219
49	WISCONSIN	14,251	13,863
50	WYOMING	143	163
51	ALL OTHER (FOREIGN)	549	715
52	UNDESIGNATED	125,537	197,194
	TOTAL DEPARTMENT OF ENERGY	2,351,199	2,652,868

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

03/08/90
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ALABAMA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	289	150
II. Magnetic Fusion	588	530
III. Basic Energy Sciences	408	407
TOTAL Energy Research	1,285	1,087
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	1,285	1,087
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	119	124
II. Nuclear Physics	39	45
IV. Superconducting Super Collider	40	0
TOTAL Basic Sciences	198	169
TOTAL GENERAL SCIENCE AND RESEARCH	198	169
TOTAL ALABAMA	1,483	1,256

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

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ALASKA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	313	340
III. Basic Energy Sciences	145	145
TOTAL Energy Research	458	485
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	458	485
TOTAL ALASKA	458	485

ARIZONA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	0	115
III. Basic Energy Sciences	2,510	2,219
TOTAL Energy Research	2,510	2,334
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	2,510	2,334
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	200	208
II. Nuclear Physics	38	77
IV. Superconducting Super Collider	30	0
TOTAL Basic Sciences	268	285
TOTAL GENERAL SCIENCE AND RESEARCH	268	285
TOTAL ARIZONA	2,778	2,619

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

03/08/90
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CALIFORNIA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	53,332	47,959
II. Magnetic Fusion	88,879	86,345
III. Basic Energy Sciences	118,692	136,415
VI. University Science & Education Program	747	1,241
IX. Multi-Program Energy Labs - Facilities Support	5,247	7,912
TOTAL Energy Research	266,897	279,872
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	266,897	279,872
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	181,492	189,586
II. Nuclear Physics	40,184	41,351
IV. Superconducting Super Collider	2,432	0
TOTAL Basic Sciences	224,108	230,937
TOTAL GENERAL SCIENCE AND RESEARCH	224,108	230,937
TOTAL CALIFORNIA	491,005	510,809

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

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COLORADO

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	766	859
II. Magnetic Fusion	946	905
III. Basic Energy Sciences	4,643	4,685
VI. University Science & Education Program	29	75
TOTAL Energy Research	6,384	6,524
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	6,384	6,524
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	1,578	1,618
II. Nuclear Physics	732	788
TOTAL Basic Sciences	2,310	2,406
TOTAL GENERAL SCIENCE AND RESEARCH	2,310	2,406
TOTAL COLORADO	8,694	8,930

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09:20:39 FY 1991 CONGRESSIONAL BUDGET PAGE 6
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS) CONNECTICUT

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	1,065	1,126
II. Magnetic Fusion	65	375
III. Basic Energy Sciences	1,716	1,565
TOTAL Energy Research	2,846	3,066
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	2,846	3,066
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	3,380	3,515
II. Nuclear Physics	2,924	4,100
IV. Superconducting Super Collider	175	0
TOTAL Basic Sciences	6,479	7,615
TOTAL GENERAL SCIENCE AND RESEARCH	6,479	7,615
TOTAL CONNECTICUT	9,325	10,681

DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

DELAWARE

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	48	42
III. Basic Energy Sciences	435	435
TOTAL Energy Research	483	477
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	483	477
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	272	283
TOTAL GENERAL SCIENCE AND RESEARCH	272	283
TOTAL DELAWARE	756	760

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

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DISTRICT OF COLUMBIA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	24,182	26,872
II. Magnetic Fusion	6,220	6,005
III. Basic Energy Sciences	48,276	57,897
V. Energy Research Analyses	2,550	2,063
VI. University Science & Education Programs	100	0
VIII. Advisory & Oversight Program Direction	3,326	4,250
TOTAL Energy Research	84,654	97,087
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	84,654	97,087
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	265	275
II. Nuclear Physics	371	399
III. General Science Program Direction	5,008	5,950
TOTAL Basic Sciences	5,644	6,624
TOTAL GENERAL SCIENCE AND RESEARCH	5,644	6,624
TOTAL DISTRICT OF COLUMBIA	88,478	102,511

ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

FLORIDA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	2,037	1,942
III. Basic Energy Sciences	11,980	1,006
TOTAL Energy Research	14,017	2,948
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	14,017	2,948
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	2,052	2,134
II. Nuclear Physics	191	178
IV. Superconducting Super Collider	195	0
TOTAL Basic Sciences	2,438	2,312
TOTAL GENERAL SCIENCE AND RESEARCH	2,438	2,312
TOTAL FLORIDA	16,455	5,260

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

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GEORGIA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	1,213	1,992
II. Magnetic Fusion	105	60
III. Basic Energy Sciences	4,127	4,141
TOTAL Energy Research	5,445	6,193
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	5,445	6,193
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	22	23
II. Nuclear Physics	193	205
TOTAL Basic Sciences	215	228
TOTAL GENERAL SCIENCE AND RESEARCH	215	228
TOTAL GEORGIA	5,660	6,421

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

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HAWAII

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	156	160
III. Basic Energy Sciences	90	90
TOTAL Energy Research	246	250
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	246	250
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	1,350	1,404
IV. Superconducting Super Collider	64	0
TOTAL Basic Sciences	1,414	1,404
TOTAL GENERAL SCIENCE AND RESEARCH	1,414	1,404
TOTAL HAWAII	1,660	1,654

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

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IDAHO

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	5,869	5,870
II. Magnetic Fusion	2,077	2,026
III. Basic Energy Sciences	2,665	2,595
VI. University Science & Education Programs	2,619	1,724
IX. Multi-Program Energy Labs - Facilities Support	391	0
TOTAL Energy Research	15,621	10,215
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	15,621	10,215
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
II. Nuclear Physics	360	375
TOTAL GENERAL SCIENCE AND RESEARCH	360	375
TOTAL IDAHO	15,981	10,590

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

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ILLINOIS

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	15,995	15,460
II. Magnetic Fusion	5,495	5,745
III. Basic Energy Sciences	115,164	156,928
V. Energy Research Analyses	200	450
VI. University Science & Education Program	5,069	5,105
IX. Multi-Program Energy Labs -- Facilities Support	6,736	4,760
TOTAL Energy Research	140,655	184,448
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	140,655	184,448
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	218,015	238,771
II. Nuclear Physics	15,906	15,370
IV. Superconducting Super Collider	2,750	0
TOTAL Basic Sciences	236,671	254,141
TOTAL GENERAL SCIENCE AND RESEARCH	236,671	254,141
TOTAL ILLINOIS	377,326	438,589

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ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

INDIANA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	536	340
II. Magnetic Fusion	30	30
III. Basic Energy Sciences	5,585	5,876
TOTAL Energy Research	6,121	6,246
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	6,121	6,246
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	3,605	3,749
II. Nuclear Physics	1,214	1,307
IV. Superconducting Super Collider	400	0
TOTAL Basic Sciences	5,219	5,056
TOTAL GENERAL SCIENCE AND RESEARCH	5,219	5,056
TOTAL INDIANA	11,340	11,302

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

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IOWA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	607	671
III. Basic Energy Sciences	16,449	17,025
VI. University Science & Education Programs	83	174
TOTAL Energy Research	17,139	17,870
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	17,139	17,870
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	2,016	2,097
II. Nuclear Physics	426	441
TOTAL Basic Sciences	2,442	2,538
TOTAL GENERAL SCIENCE AND RESEARCH	2,442	2,538
TOTAL IOWA	19,581	20,408

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ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS) KANSAS

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	324	371
III. Basic Energy Sciences	1,634	1,634
TOTAL Energy Research	1,958	2,005
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	1,958	2,005
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	110	114
II. Nuclear Physics	59	85
TOTAL Basic Sciences	169	199
TOTAL GENERAL SCIENCE AND RESEARCH	169	199
TOTAL KANSAS	2,127	2,204

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ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

KENTUCKY

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
III. Basic Energy Sciences	480	460
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	480	480
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
II. Nuclear Physics	58	70
TOTAL GENERAL SCIENCE AND RESEARCH	58	70
TOTAL KENTUCKY	538	550

ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

LOUISIANA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	10,063	227
III. Basic Energy Sciences	500	300
TOTAL Energy Research	10,563	527
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	10,563	527
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	555	577
II. Nuclear Physics	445	460
TOTAL Basic Sciences	1,000	1,037
TOTAL GENERAL SCIENCE AND RESEARCH	1,000	1,037
TOTAL LOUISIANA	11,563	1,564

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

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MAINE

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	127	130
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	127	130
TOTAL MAINE	127	130

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
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MARYLAND

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	2,011	2,356
II. Magnetic Fusion	1,903	1,710
III. Basic Energy Sciences	1,806	1,655
TOTAL Energy Research	5,720	5,721
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	5,720	5,721
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	4,092	3,871
II. Nuclear Physics	1,733	1,581
TOTAL Basic Sciences	5,825	5,452
TOTAL GENERAL SCIENCE AND RESEARCH	5,825	5,452
TOTAL MARYLAND	11,545	11,173

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

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MASSACHUSETTS

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	4,062	4,770
II. Magnetic Fusion	23,519	23,500
III. Basic Energy Sciences	8,628	8,351
TOTAL Energy Research	36,189	36,621
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	36,189	36,621
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	18,254	17,512
II. Nuclear Physics	16,226	16,648
IV. Superconducting Super Collider	500	0
TOTAL Basic Sciences	34,980	34,160
TOTAL GENERAL SCIENCE AND RESEARCH	34,980	34,160
TOTAL MASSACHUSETTS	71,169	70,781

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ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

MICHIGAN

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	1,538	1,929
III. Basic Energy Sciences	4,884	4,936
TOTAL Energy Research	6,422	6,865
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	6,422	6,865
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	3,933	3,333
II. Nuclear Physics	197	204
IV. Superconducting Super Collider	274	0
TOTAL Basic Sciences	4,404	3,537
TOTAL GENERAL SCIENCE AND RESEARCH	4,404	3,537
TOTAL MICHIGAN	10,826	10,402

DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

MINNESOTA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
III. Basic Energy Sciences	2,063	2,038
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	2,063	2,038
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	2,140	2,226
II. Nuclear Physics	693	735
TOTAL Basic Sciences	2,833	2,961
TOTAL GENERAL SCIENCE AND RESEARCH	2,833	2,961
TOTAL MINNESOTA	4,896	4,999

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

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MISSISSIPPI

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
III. Basic Energy Sciences	807	807
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	807	807
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	100	104
TOTAL GENERAL SCIENCE AND RESEARCH	100	104
TOTAL MISSISSIPPI	907	911

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

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MISSOURI

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	791	964
II. Magnetic Fusion	80	90
III. Basic Energy Sciences	1,054	1,339
TOTAL Energy Research	1,925	2,393
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	1,925	2,393
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	250	260
II. Nuclear Physics	363	390
TOTAL Basic Sciences	613	650
TOTAL GENERAL SCIENCE AND RESEARCH	613	650
TOTAL MISSOURI	2,538	3,043

SBP2 DEPARTMENT OF ENERGY 01/08/90
09:28:19 FY 1991 CONGRESSIONAL BUDGET PAGE 26
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS) MONTANA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
III. Basic Energy Sciences	42	42
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	42	42
TOTAL MONTANA	42	42

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

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NEBRASKA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	48	70
III. Basic Energy Sciences	290	290
TOTAL Energy Research	338	360
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	338	360
TOTAL NEBRASKA	338	360

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

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NEVADA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
III. Basic Energy Sciences	93	93
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	93	93
TOTAL NEVADA	93	93

NEW HAMPSHIRE

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
II. Magnetic Fusion	162	70
III. Basic Energy Sciences	386	381
TOTAL Energy Research	548	451
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	548	451
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
II. Nuclear Physics	360	370
TOTAL GENERAL SCIENCE AND RESEARCH	360	370
TOTAL NEW HAMPSHIRE	908	821

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DEPARTMENT OF ENERGY
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ENERGY RESEARCH ACTIVITIES BY STATE
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NEW JERSEY

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	654	705
II. Magnetic Fusion	84,005	87,344
III. Basic Energy Sciences	2,925	2,110
TOTAL Energy Research	87,582	90,157
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	87,582	90,157
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	5,570	5,572
II. Nuclear Physics	52	63
IV. Superconducting Super Collider	200	0
TOTAL Basic Sciences	5,822	5,635
TOTAL GENERAL SCIENCE AND RESEARCH	5,822	5,635
TOTAL NEW JERSEY	91,404	95,792

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NEW MEXICO

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	25,040	27,047
II. Magnetic Fusion	25,395	25,240
III. Basic Energy Sciences	28,794	31,469
VI. University Science & Education Progrm	246	548
TOTAL Energy Research	79,475	84,304
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	79,475	84,304
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	823	855
II. Nuclear Physics	55,173	55,435
IV. Superconducting Super Collider	348	0
TOTAL Basic Sciences	56,344	56,290
TOTAL GENERAL SCIENCE AND RESEARCH	56,344	56,290
TOTAL NEW MEXICO	135,819	140,594

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NEW YORK

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	33,305	35,692
II. Magnetic Fusion	3,777	3,650
III. Basic Energy Sciences	76,751	89,495
V. Energy Research Analyses	120	120
VI. University Science & Education Program	740	1,134
IX. Multi-Program Energy Labs - Facilities Support	5,841	4,566
TOTAL Energy Research	120,534	134,657
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	120,534	134,657
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	88,316	87,935
II. Nuclear Physics	29,059	47,225
IV. Superconducting Super Collider	1,170	0
TOTAL Basic Sciences	118,545	135,160
TOTAL GENERAL SCIENCE AND RESEARCH	118,545	135,160
TOTAL NEW YORK	239,079	269,817

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ENERGY RESEARCH ACTIVITIES BY STATE
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NORTH CAROLINA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	1,306	1,465
III. Basic Energy Sciences	1,580	1,576
TOTAL Energy Research	2,886	3,041
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	2,886	3,041
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	718	728
II. Nuclear Physics	2,437	2,442
TOTAL Basic Sciences	3,155	3,170
TOTAL GENERAL SCIENCE AND RESEARCH	3,155	3,170
TOTAL NORTH CAROLINA	6,041	6,211

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ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS) OHIO

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	1,345	1,282
III. Basic Energy Sciences	1,661	1,458
VI. University Science & Education Progrms	67	99
TOTAL Energy Research	3,073	2,839
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	3,073	2,839
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	2,270	2,252
II. Nuclear Physics	544	578
TOTAL Basic Sciences	2,814	2,830
TOTAL GENERAL SCIENCE AND RESEARCH	2,814	2,830
TOTAL OHIO	5,887	5,669

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OKLAHOMA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
III. Basic Energy Sciences	834	834
VI. University Science & Education Program	297	0
TOTAL Energy Research	1,131	834
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	1,131	834
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	540	562
IV. Superconducting Super Collider	60	0
TOTAL Basic Sciences	600	562
TOTAL GENERAL SCIENCE AND RESEARCH	600	562
TOTAL OKLAHOMA	1,731	1,396

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OREGON

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	10,436	694
III. Basic Energy Sciences	835	835
TOTAL Energy Research	11,271	1,529
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	11,271	1,529
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	425	442
II. Nuclear Physics	283	306
IV. Superconducting Super Collider	140	0
TOTAL Basic Sciences	848	748
TOTAL GENERAL SCIENCE AND RESEARCH	848	748
TOTAL OREGON	12,119	2,277

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PENNSYLVANIA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	1,119	1,177
II. Magnetic Fusion	50	50
III. Basic Energy Sciences	4,518	4,391
TOTAL Energy Research	5,687	5,618
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	5,687	5,618
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	5,526	5,521
II. Nuclear Physics	1,951	2,135
IV. Superconducting Super Collider	540	0
TOTAL Basic Sciences	8,017	7,656
TOTAL GENERAL SCIENCE AND RESEARCH	8,017	7,656
TOTAL PENNSYLVANIA	13,704	13,274

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PUERTO RICO

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	100	75
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	100	75
TOTAL PUERTO RICO	100	75

RHODE ISLAND

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	418	450
III. Basic Energy Sciences	760	636
TOTAL Energy Research	1,178	1,086
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	1,178	1,086
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	1,988	1,295
II. Nuclear Physics	271	260
TOTAL Basic Sciences	2,259	1,555
TOTAL GENERAL SCIENCE AND RESEARCH	2,259	1,555
TOTAL RHODE ISLAND	3,437	2,641

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SOUTH CAROLINA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	746	960
III. Basic Energy Sciences	251	251
VI. University Science & Education Programs	155	223
TOTAL Energy Research	1,152	1,434
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	1,152	1,434
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	270	281
TOTAL GENERAL SCIENCE AND RESEARCH	270	281
TOTAL SOUTH CAROLINA	1,422	1,715

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ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS) SOUTH DAKOTA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
III. Basic Energy Sciences	100	100
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	100	100
TOTAL SOUTH DAKOTA	100	100

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ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS) TENNESSEE

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	31,019	34,954
II. Magnetic Fusion	40,832	42,360
III. Basic Energy Sciences	76,828	80,954
V. Energy Research Analyses	300	600
VI. University Science & Education Programs	2,827	3,029
IX. Multi-Program Energy Labs - Facilities Support	3,906	6,505
TOTAL Energy Research	155,712	168,402
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	155,712	168,402
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	989	1,029
II. Nuclear Physics	16,222	16,669
IV. Superconducting Super Collider	474	0
TOTAL Basic Sciences	17,685	17,698
TOTAL GENERAL SCIENCE AND RESEARCH	17,685	17,698
TOTAL TENNESSEE	173,397	186,100

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TEXAS

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	1,034	1,200
II. Magnetic Fusion	8,185	7,650
III. Basic Energy Sciences	4,086	4,032
TOTAL Energy Research	13,305	12,882
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	13,305	12,882
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	1,962	2,040
II. Nuclear Physics	4,332	4,320
IV. Superconducting Super Collider	198,741	302,866
TOTAL Basic Sciences	205,035	309,226
TOTAL GENERAL SCIENCE AND RESEARCH	205,035	309,226
TOTAL TEXAS	218,340	322,108

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UTAH

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	1,190	1,332
III. Basic Energy Sciences	954	1,265
VI. University Science & Education Program	1,422	1,088
TOTAL Energy Research	3,566	3,685
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	3,566	3,685
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
II. Nuclear Physics	99	105
TOTAL GENERAL SCIENCE AND RESEARCH	99	105
TOTAL UTAH	3,665	3,790

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VERMONT

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	465	335
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	465	335
TOTAL VERMONT	465	335

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VIRGINIA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	1,010	1,144
II. Magnetic Fusion	180	175
III. Basic Energy Sciences	1,675	1,541
V. Energy Research Analyses	150	150
TOTAL Energy Research	3,015	3,010
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	3,015	3,010
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	1,032	979
II. Nuclear Physics	82,907	93,424
TOTAL Basic Sciences	83,939	94,403
TOTAL GENERAL SCIENCE AND RESEARCH	83,939	94,403
TOTAL VIRGINIA	86,954	97,413

ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

WASHINGTON

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	25,049	28,817
II. Magnetic Fusion	6,887	7,150
III. Basic Energy Sciences	11,771	11,736
V. Energy Research Analyses	500	500
VI. University Science & Education Program	1,162	1,079
TOTAL Energy Research	45,369	49,082
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	45,369	49,082
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	1,314	1,367
II. Nuclear Physics	3,604	3,610
IV. Superconducting Super Collider	171	0
TOTAL Basic Sciences	5,089	4,977
TOTAL GENERAL SCIENCE AND RESEARCH	5,089	4,977
TOTAL WASHINGTON	50,458	54,059

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WEST VIRGINIA

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
III. Basic Energy Sciences	201	219
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	201	219
TOTAL WEST VIRGINIA	201	219

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WISCONSIN

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	596	815
II. Magnetic Fusion	5,578	5,830
III. Basic Energy Sciences	1,880	1,872
TOTAL Energy Research	8,054	8,517
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	8,054	8,517
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	4,076	5,216
II. Nuclear Physics	121	130
TOTAL Basic Sciences	4,197	5,346
TOTAL GENERAL SCIENCE AND RESEARCH	4,197	5,346
TOTAL WISCONSIN	14,251	13,863

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WYOMING

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
III. Basic Energy Sciences	113	113
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	113	113
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
II. Nuclear Physics	30	50
TOTAL GENERAL SCIENCE AND RESEARCH	30	50
TOTAL WYOMING	143	163

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ALL OTHER (FOREIGN)

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	549	715
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	549	715
TOTAL ALL OTHER (FOREIGN)	549	715

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UNDESIGNATED

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
Energy Research		
I. Biological and Environmental Research	49,762	87,242
II. Magnetic Fusion	17,305	19,660
VI. University Science & Education Program	11,352	16,241
VII. University Research Instrumentation	4,930	4,924
TOTAL Energy Research	83,349	128,067
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	83,349	128,067
GENERAL SCIENCE AND RESEARCH		
Basic Sciences		
I. High Energy Physics	22,458	35,329
II. Nuclear Physics	9,864	18,798
IV. Superconducting Super Collider	9,866	15,000
TOTAL Basic Sciences	42,188	69,127
TOTAL GENERAL SCIENCE AND RESEARCH	42,188	69,127
TOTAL UNDESIGNATED	125,537	197,194

DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
ENERGY RESEARCH ACTIVITIES BY STATE
(IN THOUSANDS)

	FY 1990 ESTIMATE	FY 1991 ESTIMATE
TOTAL DEPARTMENT OF ENERGY	2,351,199	2,652,868

Mrs. BOGGS. Thank you. When Dr. Bromley, the President's Science Advisor, appeared before another subcommittee on which I sit, he indicated that the Administration had great support for transplanting a National Science Foundation program that's been designed to improve the geographic distribution of research support. The program is called the EPSCR Program, the Experimental Program to Stimulate Competitive Research to Other Departments and Agencies.

Are you familiar with that program, and will you consider ways in which your Department, and, in particular, the National labs, might work with State EPSCR committees to improve the diversity of research proposals you will receive?

Dr. DECKER. I'm not familiar with that program and certainly would like to learn about it and would be very interested in the possibility that we might be able to use it.

Mrs. BOGGS. It's a very interesting program that NSF has embarked upon to try to get into the geographic areas, into the universities, which have not been able to tie into a great deal of the research in the past and to make certain that the research in competitive programs is spread to those areas.

It's a very interesting statistic that you find that most of the States can participate in the EPSCR Program. Then they can spend more of their own money, proportionately to try to stimulate and attract research. This will make them competitive with those States that are just blessed with a great largesse of research activities.

But I was very pleased that Dr. Bromley felt that the NSF program was working sufficiently well to suggest that it could be applied to other programs across the Government which could perhaps enter into the same type of program.

Dr. DECKER. I'll make it a point to call Dr. Bromley and talk with him about it.

Mrs. BOGGS. The Energy Research and Development Administration Act gives DOE the responsibility for "helping to assure an adequate supply of manpower for the accomplishment of energy research and development programs by sponsoring and assisting in education and training activities in institutions of higher education, vocational schools, and other institutions."

Given that responsibility and given the fact that, as Dr. Bromley recently stated, 75 percent of high school students complete their college education within 50 miles of their home town, what programs do you have underway to assure that the Department's education initiatives are made available to States that traditionally have not had a close working relationship with the Department or with its National labs?

Dr. DECKER. I think I'd like to ask, if you don't mind, Dr. Toni Joseph, who runs that particular program, to come up and give you a very complete answer.

Mrs. BOGGS. Thank you. Would you identify yourself for the record?

EDUCATION PROGRAMS

Dr. JOSEPH. I'm Toni Joseph. As you know, we have several programs in our science education area that are National programs that are Nationally competed for.

The major one for undergraduates is one that does involve using the resources of the laboratories for a summer program for hands on research for about 100 undergraduate students.

That's been expanded, to also include a semester program for students in science and engineering, usually in their junior year. We'll have 325 semester students in the Fiscal Year 1991 budget.

These people are Nationally selected, many of the students in these programs come from the smaller colleges and areas that don't have major research facilities to use at those colleges, particularly, the Midwest and the Southeast.

So those National programs do reach all college students across the country. In the programs that we have for pre-college students that really do involve using the laboratories, as Dr. Decker commented earlier, to help turn young students on to science with the hands on science experience, those, in some cases, are tied to the region around the laboratory, but are also done on a basis so that each laboratory's region is expanded to include other States. We can provide support for transportation and sometimes housing in order for them to use the facilities.

It's harder for the younger students, but we've found that for the teachers in these programs and for high school students, we have set up a system like the lab co-op program where now we pick the teachers Nationwide, and then provide them travel or have housing at the laboratory within their region.

So with the distribution of laboratories across the country, we're managing to be able to be accessible Nationwide for these programs.

It started out much more regional than they are right now.

Mrs. BOGGS. It's a very encouraging report. But then we get back to the situation where we have young people attending the colleges that are within a 50-mile radius of their homes. Will they have the facilities within those colleges to be able to come into the work force that you and Admiral Watkins and Dr. Bromley have pointed out that we're going to need?

Dr. JOSEPH. One of the programs in our area that we have to help support those colleges is the University Research Instrumentation Program, and that's about $5 million a year for new scientific instrumentation above $100 thousand, the kind that you don't get with just a research proposal.

But in this program, over the six years we've been doing it, we have provided research instrumentation to 31 States, so it's a broad number of colleges and universities, and often this research instrumentation, then, can attract the additional research funding in the out years. We do have a provision that the instrumentation have substantial numbers of graduate students associated with using that facility. We also encourage the instructions to be shared by colleges in the area that don't have such instruments as part of a program where they bring them in. They are allowed to use that

instrumentation, and that's built into the award for that instrumentation.

Mrs. BOGGS. I think that's a very, very wise direction in which to go. The idea of colleges being able to use facilities and instrumentation and the expert teachers is just very exciting and valuable.

Is there anything else you'd like to add?

Dr. JOSEPH. One other is the University Research Reactor Program and the research reactors on campus. We have a Reactor Sharing Program, and there are awards to small colleges that don't have reactors to come to those places, and we fund the travel and the extra dollars that are needed to run these research reactors for these other colleges.

Mrs. BOGGS. Thank you very much.

CENTER FOR ADVANCED MICROSTRUCTURES

Thank you, Dr. Decker, for having that splendid report. What is the status of the Center for Advanced Microstructures and Devices, CAMD, at LSU in Baton Rouge?

Dr. DECKER. I'm not sure that I can tell you in detail. I understand that work on the synchrotron light source, which is a key component of that, is moving along quite well.

I know that we have had some of our staff from the Office of Basic Energy Sciences go down and meet with the people there and work with them.

There are people from Brookhaven who have gone down to try to provide assistance in getting that synchrotron light source on line successfully.

GLOBAL CHANGE INSTITUTE

Mrs. BOGGS. Last year, the subcommittee encouraged the Department to establish an institute to study global and environmental change. What's the status of this initiative?

Dr. DECKER. We have a draft proposal for that center. We have been negotiating with the universities involved to come up with a good program.

We would expect that there will be a final proposal that we will fund that will come to us in the very near future, so I think it's moving along quite well at this point.

TRANSFER OF REACTOR RESPONSIBILITIES

Mrs. BOGGS. Why are the high flux isotope reactor and the high flux beam reactor being transferred to the jurisdiction of the Assistant Secretary for Nuclear Energy, while funding responsibility remains with the program offices? How will this affect safety and operational efficiency?

Dr. DECKER. I think there was a very sort of pragmatic reason for moving the operations of those reactors to the Assistant Secretary for Nuclear Energy.

In the Office of Energy Research, we had never built up a capability with appropriate nuclear engineers and so forth to provide the good safety oversight that Secretary Watkins would like to see out of the program offices.

We had relied primarily on field offices to carry that out for us in the past. With Secretary Watkins wanting the individual programs in Washington to have their own internal capabilities, there just simply were not enough trained people in that area to build up both an organization in nuclear energy, one in energy research, and then another one over in defense programs.

So the sensible thing was to combine the operation of the research reactors on the civilian side into one organization into nuclear energy.

The budget, as you said, does remain in the Office of Energy Research, and I think that is appropriate, because we are the program that uses those reactors for research purposes.

PROTON BEAM THERAPY

Mrs. BOGGS. I understand the new proton beam therapy facility at Loma Linda University is nearing completion. What do you think the next step should be in the development of the use of this treatment?

Should DOE or NIH continue to support new facilities?

Dr. DECKER. One of the things that we are currently doing in our nuclear medicine program is to continue to do research using various ion beams at the Lawrence Berkeley Laboratory.

One of the questions is whether or not it is advantageous to use some heavier ions in this kind of therapy. The Loma Linda facility, if I remember correctly, uses just protons.

There are certainly good reasons to believe theoretically that heavier ions, such as carbon, would be more effective, particularly for some types of tumors that are in very delicate locations where one has to be very careful about destroying surrounding tissue.

That research is continuing on at Berkeley, and I think based on the results of that research, if it's successful, one would consider the possibility of, you know, some additional facilities for therapy.

Mrs. BOGGS. Thank you so much, Doctor. I have other questions, but I've used too much time. Thank you.

Mr. BEVILL. The Chair recognizes Mr. Pursell.

Mr. PURSELL. Thank you, Mr. Chairman.

PETT PROGRAM

In your general science category, you're looking at the PETT Program and positron emission topography. What support are you providing in that area? Where are you going with that program?

Dr. DECKER. Offhand I believe the financial support is about $11 million.

Mr. PURSELL. Is that relatively a new program?

Dr. DECKER. No, it's been going on for a number of years. I can't tell you exactly how long.

Mr. PURSELL. Could you submit that for the record for me?

Dr. DECKER. Sure.

Mr. PURSELL. Give me sort of a chronological historical background on that.

Dr. DECKER. I'll be glad to do that.

[The information follows:]

BACKGROUND INFORMATION AND A HISTORICAL CHRONOLOGY OF POSITRON EMISSION TOMOGRAPHY

Positron emission tomography (PET) is a well-established technique for investigating the physiological and biochemical properties of tissues in vivo. While the technique has been used primarily for investigational studies of the heart and brain, it now is becoming established as a clinical tool. It shows promise of having a significant impact in diagnosing and treating diseases such as epilepsy, stroke, brain tumors, and dementia. PET's potential is expanding. The technology makes possible the quantification of regional chemistry within the living human body to an extent not otherwise possible.

A pamphlet explaining the basic principles of PET, its brief chronology, its value and role relative to other imaging modalities in the diagnostic process has recently been prepared.

Mr. PURSELL. Are there any changes in the objectives of the PETT Program? Are they being revised or augmented?

Dr. DECKER. It's basically trying to improve the technique and finding new applications for it. Those are the main thrusts of the program right now.

Mr. PURSELL. Okay. I have a couple other questions I want to submit to the record on that area, which I'll do on behalf of the committee.

FUSION

Mr. PURSELL. I want to take a few minutes on the fusion program, basically ICF. How many laboratories are dealing with the ICF program.

Dr. DECKER. As you know, I don't have responsibility for the ICF Program, but my recollection is that Los Alamos, Sandia and Livermore are the three main DOE laboratories who are involved.

KMS Fusion, as you know, has been involved as a private company. The University of Rochester has a program, and I believe the Naval Research Laboratory still has a program.

We in Energy Research do support some research which is related to heavy ion fusion, another approach to inertial confinement, and that work is done at the Lawrence Berkeley Laboratory.

Mr. PURSELL. The Secretary has appointed an advisory panel to look at the short and long term objectives of both magnetic and ICF. Will that involve your office in any way?

Dr. DECKER. Yes, I have worked with the Secretary in setting up that panel, and the administrative handling of the panel's activities will be done by a little group in my office that has been responsible for handling the Energy Research Advisory Board.

They're used to dealing with advisory committee kinds of activities.

Mr. PURSELL. That's why I was asking. That will continue?

Dr. DECKER. That will continue, and, of course, staff in both the Magnetic Fusion Program and the Inertial Confinement Program will be providing information for the committee's use.

Mr. PURSELL. As the Chairman pointed out, we've had a long history with fusion, more in magnetic than ICF. What's your professional opinion of the role of fusion in terms of energy policy.

Where do you see that in the short and long term? What's your prognosis of that personally?

Dr. DECKER. Well, in the Magnetic Fusion Program, as I was indicating earlier, we are very close to this break-even condition.

Mr. PURSELL. You mentioned that earlier.

Dr. DECKER. Right. I do not know the Inertial Confinement Program as well, and I would hate to make a prognosis there.

But on magnetic fusion, I would say that, you know, in the next couple of years you'll see break-even conditions met certainly in JET in Europe, and there's a good chance that we'll be very close if we don't make it in TFTR Princeton.

Mr. PURSELL. With the changing historical climate in Europe and elsewhere, what do you see the role of fusion in civil applications?

Is there a possibility of broadening the application to areas besides the Defense and National Security interests? Is there a place for the private sector in the expansion of fusion for medical laboratories and other purposes? Is that something that we ought to be looking at or not?

Dr. DECKER. Well, of course, the Magnetic Fusion Program goals has been almost entirely from its inception, I think, to be a commercial power source, energy source.

Mr. PURSELL. Right.

Dr. DECKER. Although, there are other potential applications. The Inertial Confinement Program, I think, of course, has not been pursued from that point of view, and it's been a little further away from application.

It hasn't been pursued as long, and is a little bit behind magnetic, technically I think, in most people's view. They have not been as concerned about the potential energy applications, because I think everything that they're doing on the military side are things that you would do to get to a commercial fusion power plant if that were in the cards anyway.

FUSION POLICY ADVISORY COMMITTEE

Mr. PURSELL. In a letter Admiral Watkins submitted to the committee, he advised of the fusion review.

I have no personal opinion on the proposal to transferring $50 million from the magnetic fusion to ICF.

Was that part of a DOE proposal or was that an outside recommendation? Is the advisory panel to look at that. That's one of the questions and I think that it is appropriate to review.

Dr. DECKER. That's right. I believe that that transfer of funds was proposed by Robert Hunter when he was the Director of the Office of Energy Research.

Mr. PURSELL. So that will be part of the advisory panel's considerations?

Dr. DECKER. That's correct. They had been asked to review a draft program plan that Dr. Hunter had devised, and that draft plan would provide for a direct competition between magnetic and inertial confinement fusion.

The Secretary has a very open mind with regard to, you know, the outcome of this particular panel's work, and he is not married to that particular plan.

Mr. PURSELL. I think he's honestly asking a basic question that we have been asking. Where are we going in fusion in the next 10, 15, 20, 30 years, financially and programmatic. I think he's asking the basic bottom line question.

Dr. DECKER. That's correct. That's exactly why he's asking. He really wants this panel to come up with a strategy which hopefully will be an enduring strategy for, some time in the future.

Mr. PURSELL. I don't know all the people on this panel. I looked at it, and they are predominant people from the University of California and the laboratories.

I guess that's part of the process, and I'm not going to evaluate the pros and cons but there's more people from the universities and laboratories than there are from the private sector.

I only find two from the private sector. Hopefully, the panel will have some positive recommendations for the committee and for the Department of Energy and the Nation.

Dr. DECKER. I think there are some ex-laboratory people on there, I think. I don't know if there's anyone that's directly associated with the laboratory anymore.

We had hoped to have some additional people from the private sector, but, unfortunately, we were turned down by a couple of people.

NATIONAL ENERGY POLICY

Mr. PURSELL. Are you directly involved in developing the long term energy policy? I attended the hearing in Detroit, and I'm impressed that you are looking at the long term overall comprehensive energy policy for the country.

Are you going to play a major role in that development yourself?

Dr. DECKER. Yes, I definitely will play a role in that, particularly in the parts associated with the basic science programs and magnetic fusion.

Mr. PURSELL. When will the first draft of that be available for the committee?

Dr. DECKER. The first output of that study will be available, I believe, next month. What that document will contain, I believe, is really a look at all of the input that we have received from the hearing process and the people who have written in.

It will be a discussion of various energy options from the point of view of what are the obstacles to pursuing these particular energy strategies——

Mr. PURSELL. Will the recommendations be prioritized by DOE, or will we just get a mass of information without a set of coherent recommendations?

Dr. DECKER. It's closer to the latter, because the way the process is structured, the next steps will be to go through a period of additional public comment, and then I believe the goal is by the end of year to actually put together a final strategy document that says here's what we believe the country should really do.

Mr. PURSELL. These should be our priorities.

Dr. DECKER. Yes.

Mr. PURSELL. All right.

Thank you, Mr. Chairman.

Mr. BEVILL. The Chair recognizes Mr. Chapman.

SUPERCONDUCTING SUPER COLLIDER

Mr. CHAPMAN. Dr. Decker, thank you for your excellent testimony today. Let me explore, in the few minutes I have with you, some of the questions that I've had folks asking me.

I know it may sound like the SSC is consuming an enormous amount of the time of the committee in these hearings, but I hope that you're hearing here from our Chairman, as well as the other members of this subcommittee, as I hope the Secretary heard, a tremendous amount of concern about this project. Many of us fear what may be a very difficult year.

Congressional support may be eroding for the SSC, and, again, this is said from the perspective of one who is a strong proponent of the project and certainly a strong and good friend of DOE in trying to move the project forward.

I have questions, though, of my own that I would like to ask.

To my colleague, Mr. Myers, let me make a comment, John, that's perhaps a little bit of an answer to an issue that you raised, vis-a-vis the Texas financial commitment to the project.

The voters in Texas amended the State Constitution in a Statewide referendum to authorize participation, the amount of participation, and amended our Constitution to enable the creation of a SSC commission.

It would literally require a Constitution amendment and referendum of the voters for the State of Texas at this point to back off.

So the commitment was there, and it was not anything that was done for the Governor legislatively. It was done by a Statewide vote of people.

Mr. MYERS. If you would yield, and I won't take your time, but that does concern me somewhat, the power to giveth and the power to taketh away.

Some future referendum also might rescind the funds. That bothers me a little bit. This is going to be, as you'll agree, a long term financial arrangement. I'm not suggesting the State would do that, but I'd like to make sure that they cannot change their mind.

Mr. CHAPMAN. Well, I believe there is a firm agreement being negotiated at this time, to actually place the amount of Texas commitment. Texas witnesses last year testified that Texas is willing to frontload the cost of the project.

They are willing to make the bulk of their contributions, in the early stages of the project.

I have some questions I want to ask just out of curiosity. Was there any consideration of using the Corps of Engineers as the management firm that will do the detail design and cost estimates.

Do you have any idea why not? Didn't the expertise exist within our own Federal Government to do that very work? I'm just curious as to why the Corps of Engineers apparently was never considered.

Dr. DECKER. Because I think that this is a job that can be done well by the private sector, and therefore it's a job that should go to the private sector.

Mr. CHAPMAN. I mean, if we have our own Federal engineers and we're paying them for their expertise?

And I say that simply because folks with the Corps told me they could have done this. They've managed massive construction projects that do this kind of thing and could have done it in-house and would have been happy to help. Apparently they were never considered by the Department of the Energy.

I'm just curious as to what the thinking was.

Dr. DECKER. I don't think I can add anything to that. You really are referring to this architect engineering and construction management contract.

I don't think I can add anything more, just that it's clearly a job that a number of firms could handle, and it certainly doesn't seem to me to be appropriate for the Government to compete with private areas where they don't have some clear superiority.

Mr. CHAPMAN. We do that all the time, though. The Corps of Engineers competes heads up with private firms all the time in many aspects of things we do.

SSC MANAGEMENT

Who in the Department of Energy is the point person for the SSC, Dr. Decker? The main person whose job it is to wake up every morning and say I wonder what's happening down in Texas today or I wonder what's happening at URA. Who is the point person?

Dr. DECKER. Right now, it's the Acting Associate Director of the Office of Energy Research for the SSC Program, and that's Lou Ianniello.

We are actively recruiting to fill that position on a permanent basis. In fact, we have gone through a Nationwide recruitment.

We received a large number of applicants for the position, and I would expect that personnel will provide me with some smaller set that they believe is qualified sometime next week.

Mr. CHAPMAN. Now, will that be someone whose only job is the SSC or would that just be one of the jobs they would have?

Dr. DECKER. No, that person's sole responsibility will be the SSC Program.

Mr. CHAPMAN. Okay. That decision has not been made, so we're some $400 million or $500 million into this project, from the standpoint of the Federal commitment, and we still don't have anybody at DOE who's looking out for this project.

Dr. DECKER. No, I wouldn't put it that way. I mean, we have had somebody, essentially Lou Ianniello, who has been doing the job, but he has been doing it on an acting basis, and we want to get in a very experienced project manager to fill this position on a permanent basis.

Mr. CHAPMAN. Well, that has been one of the concerns of a number of members. It's been one of my concerns. We're in the third or fourth funding cycle now, we've spent hundreds of millions of dollars, and we don't even have anybody permanently on board that's looking out after the SSC.

I urge you to please hasten that process. I'm concerned about the management of this project and concerned that we're spending hundreds of millions of dollars, and there's not one single person at DOE who has had the responsibility to report to you and the Departments management what's going on.

MAGNET RESEARCH AND DEVELOPMENT

Your testimony indicates that there will be an industrial contractor who will finalize the magnet design and that they will be selected. When will that selection take place?

Dr. DECKER. We would hope to go out with a request for proposal for Phase Two of the Magnet Industrialization Program sometime this Spring and probably have a contract in place sometime this Summer.

Mr. CHAPMAN. Who's in the running for that, if I may ask? Do you have any ideas at this point?

Dr. DECKER. No, I'm not sure I could give you—

Mr. CHAPMAN. How many possible bidders are there?

Dr. DECKER. We've had I think 16 firms that have participated in Phase One.

Mr. CHAPMAN. Okay. Who is actually doing the magnet R&D right now?

Dr. DECKER. Right now, the magnet R&D is being done by several of the DOE laboratories. We have good expertise at Brookhaven and Fermilab and some in Berkeley that we have brought to bear on this problem.

Of course, that is being led now by the new SSC laboratory.

Mr. CHAPMAN. I'm asking because I don't understand. If there's going to be a contract or an RFP to do a finalized magnet design to one or more teams in the private sector, then they would presumably do the final magnet design, yet today we understand that DOE, through its own labs, has redesigned the magnets.

In fact, one of the reasons we have a cost increase is that we're going to change the magnet aperture from four centimeters to five centimeters, and we're going to shorten the magnet from 17 meters to 15 meters.

That sounds an awful lot like a redesign to me. So I'm a little confused and I'm wondering why are we going out for bids to redesign something DOE has already redesigned? Are we going to redesign it again?

Dr. DECKER. No. Let me try to explain that. At the present time, we certainly have the best magnet designing capabilities within our own laboratories, but we need to bring the industrial people in to work with us in that redesign.

We need to get an industrial contractor up to speed as quickly as we can in this whole technology, because they're the ones in the end who are going to have to produce it, and they're going to have to be heavily involved in putting together the engineering design from which we will actually build these magnets.

Mr. CHAPMAN. Then shouldn't they have been involved from the outset or certainly in the process of this last redesign? I mean, if they ultimately tell you that you can't efficiently build a magnet 15 meters long with a five-centimeter center circumference, it would have been nice to know that before you designed it that way.

Dr. DECKER. We will have them involved in this redesign. We will, of course, be starting it before they get on board, but they will be an integral participant in the redesign process.

SSC INTERNATIONAL PARTICIPATION PLAN

Mr. CHAPMAN. Let me turn to the international plan briefly. It says in your testimony that you intend to brief the Congress in the near future. When is that?

Dr. DECKER. I believe that's in the next couple of weeks, but I might have said that a couple of weeks ago.

Mr. CHAPMAN. I've been hearing it for about six months.

Dr. DECKER. I know.

Mr. CHAPMAN. Again, in the testimony, I'm just curious that the international plan was developed in cooperation with OMB, Office of Science Technology Policy, NSC, National Science Foundation, Commerce and State Departments. All of these folks are involved in the plan but nowhere in this list is a mention of the Congress.

Has any member of Congress been consulted on this international plan as it's been developed?

Dr. DECKER. No, not yet, but we certainly intend to do that. I felt that it was a useful approach that we work through all of the legal framework and all that sort of thing within the Executive Branch, and then I think we need to tell the appropriate members of Congress what our plan is and see whether they feel it's acceptable before we go out and make additional contacts with foreign countries. That's been the plan.

Mr. CHAPMAN. Well, from the standpoint of those of us, as the Chairman has said, that are supportive of the project, we need something we can understand. We're not the technical experts and physicists, but we're the ones who are going to have to go to bat for the project.

We would have hoped that we would have had some input into the plan, because we're the ones who are going to have to sell it to our colleagues.

I certainly hope that the Department does move forward and I would just simply say that there are those of us that would like to be part of that process at the very earliest moment that it is appropriate.

Not because we want to pick anything apart, but because we might have some perspective in how we can help present that to our colleagues later this year.

I think this project has some problems. Quite frankly, it's has some problems that I didn't anticipate and I'm disappointed about it.

One of them is the tardiness in getting this international plan put together and the cost estimates that we're having trouble putting together. It's making our job, those of us that support the project, terribly difficult.

I know you're doing everything you can, but it is tough for us, and I just hope that on those two key elements that you will bring members of Congress in as quickly as you can.

I want to ask questions in one final area. In looking at page 15 of your testimony, there's a $116 million request for operating expenses to provide for enhanced level of R&D for the superconducting magnets, and then down two paragraphs later, a construction request of $168.9 million to include detailed design of technical systems.

Are we talking about the design of systems that would be a part of the machine itself? What are we designing?

Dr. DECKER. Yes.

Mr. CHAPMAN. Would that be something that would be done by this industrial engineering group or would that be something that will be done in-house?

Dr. DECKER. The industrial engineering group is designing the conventional facilities, building the tunnel and those parts of the project, not the technical components.

Mr. CHAPMAN. I also notice operating expenses in support of the transition to industrial fabrication of pre-production magnets, and industrialization of magnets is also included in the construction budget.

It sounds like both things in both places. I'm trying to find out how much of this budget is going for what and are you actually going to be building anything?

You call this construction money; what are you constructing?

Dr. DECKER. It's a budget terminology. Construction money gets used for certain things in a project, and I don't claim to be an expert on it, but, in fact, a lot of detailed design, the Magnet Industrialization Program and so forth, actually falls under construction funding.

We are not digging a tunnel in Fiscal Year 1991, which you might assume is a construction item that we would be doing.

SSC PERSONNEL ON SITE

Mr. CHAPMAN. Your budget says approximately 500 people are on site at this time. What is the number of people that would be on the site a year from now?

Dr. DECKER. I'm sorry, I don't know that number. I can get it for the record, though. I'll be glad to supply it to you.

Mr. CHAPMAN. How many more people would be funded with this appropriation?

To the extent that you can, I'd like to know where we are and what that's going to be.

Dr. DECKER. Sure.

[The information follows:]

SUPERCONDUCTING SUPER COLLIDER

With an FY 1991 appropriation of $318 million, projected employment at the SSC Laboratory is 800 people by October 1990, and about 1,250 by October 1991.

REPROGRAMMING REQUESTS

Mr. CHAPMAN. Dr. Decker, within the general science budget what reprogramming requests have you made for Fiscal Year 1989 and 1990?

Dr. DECKER. The reprogramming requests?

Mr. CHAPMAN. Total.

Dr. DECKER. I can't remember any from Fiscal Year 1989, and I don't think we have any here for Fiscal Year 1990 right now.

Mr. CHAPMAN. Alright.

Dr. DECKER. There will be a reprogramming request for moving some funds within SSC to program management in DOE.

Mr. CHAPMAN. Do you know the amount of that request?

Dr. DECKER. It's $2.4 million dollars.

Mr. CHAPMAN. Do you anticipate any other reprogramming requests at this point?

Dr. DECKER. I don't think there are, no.

Mr. CHAPMAN. Okay.

Mr. Chairman, I have other questions that I would submit for the record with the permission of the Chair.

Mr. BEVILL. All right.

Mr. BEVILL. I know each member of this panel is going to be submitting other questions for the record, Dr. Decker.

Are there any other questions?

SSC OBLIGATIONS TO DATE

Mr. MYERS. Mr. Chairman, I have one or two.

In the appropriation last year, we provided about $21 million of capital equipment funds for the SSC. What type of equipment did we buy?

Most of your work is research or planning. How much have you obligated from last year's appropriation?

Dr. DECKER. This is equipment money within the SSC project?

Mr. MYERS. Well, as I recall, we appropriated $218 million.

Dr. DECKER. That's correct.

Mr. MYERS. How much of that has been obligated to this point? Would you provide it for the record?

Dr. DECKER. I'd be glad to provide it for the record.

Mr. MYERS. I realize you wouldn't have that today.

[The information follows:]

CURRENT AND PROJECTED FISCAL YEAR 1990 SSC OBLIGATIONS AND COMMITMENTS

The following table provides a breakout of FY 1990 funds currently obligated and committed, and planned obligations and commitments for the period ending September 30, 1990.

FISCAL YEAR 1990 OBLIGATION AND COMMITMENTS

[In thousands of dollars]

	Through Mar. 1, 1990		Through Sept. 30, 1990	
	Obligations	Cost and commitments	Obligations	Cost and commitments
Superconducting super collider:				
Operating expenses	63,222	24,464	68,107	67,285
Capital equipment	16,004	6,794	20,706	20,126
Construction	101,236	35,812	[1] 105,104	[1] 103,636
Total superconducting super collider	180,462	67,070	193,917	191,047

[1] $23,888 of SSC tunnel construction funding not expected to be obligated in Fiscal Year 1990.

SSC EQUIPMENT AND CONSTRUCTION

Mr. MYERS. And also I'd like to know how you could buy that much capital equipment.

Dr. DECKER. Well, the capital equipment goes, of course, to support some of the R&D efforts. We need equipment to do the magnet research, for example. That sort of thing.

Mr. MYERS. The question was asked about where the work is being done. I suppose it's being done at the DOE labs. Do you have to buy equipment at those labs?

Dr. DECKER. Yes.

Mr. MYERS. They didn't request it in their own request?

Dr. DECKER. No, if it's work done for this project, it would be budgeted under this project.

Mr. MYERS. Okay. You stated that construction money also funds planning? The construction money we appropriated last year, which was about $130 million went for planning? You haven't bought land yet, have you?

Dr. DECKER. No. In fact, we don't have to buy land because land is provided by the State of Texas.

Mr. MYERS. What was constructed, then?

Dr. DECKER. It's for the Magnet Industrialization Program, but a lot of that money has not been spent yet, because we don't have that contract in place yet.

Mr. MYERS. Will it be spent between now and the first of October?

Dr. DECKER. It will be obligated, I believe.

Mr. MYERS. It will be obligated. In the request for next year, 1991, you have a $116 million request for research and program direction, which I think we understand, but again it includes $33 million for capital equipment. Would you provide for the record what type of capital equipment is included?

Dr. DECKER. That's, again, equipment to support the R&D programs. Some will probably needed for the Magnet Development Program, and there will be some that's going for the first time in supporting R&D for the detectors that need to be built eventually.

Mr. MYERS. Provide for the record what the $169 million for construction includes.

Dr. DECKER. Sure. I'd be glad to.

[The information follows:]

SSC construction Fiscal Year 1991

	Budget authority (in millions)
Magnet Development Program	48.0
Conventional construction design	18.0
Accelerator system design	33.0
Injector system fabrication	20.0
Site preparation, utilities and structures	14.9
Project management and support	35.0
Total	168.9

NUCLEAR MEDICINE

Mr. MYERS. I have a series of other questions, but one I will ask you today, Mr. Atwater is having some problems with a tumor, and it would seem to me that would be an appropriate area for the laser surgery.

I'm not a surgeon, but are we spending enough money, again I'll ask the question, in nuclear medical research? Could we wisely spend more money there if we could find the money someplace?

Dr. DECKER. That's a very hard question for me to answer. I think that, of course, within our resources we feel we're spending an appropriate amount.

I sort of had the same question that you did when I heard about Mr. Atwater's tumor as to whether or not some of the particle beam techniques that we had developed that we were talking about a little bit earlier——

Mr. MYERS. Loma Linda.

Dr. DECKER. Loma Linda or at Berkeley might be used in that particular case, but not being a medical doctor, I have no idea.

Mr. MYERS. So at this time, you don't know whether more money would be wisely spent or even could be obligated in this area.

I guess we're all shooting in the dark then. If we should add a few million dollars, I presume it would be spent.

Dr. DECKER. It is a very good research program, there are very worthwhile things to do, and I guess the only thing I can say is that within the resources we have available to us, we thought we had allocated a reasonable amount to it.

Mr. MYERS. I think you've answered my question, then. Thank you. I have some other questions I will provide for the record.

Mr. BEVILL. Dr. Decker, we appreciate your fine presentation, and you've answered some pretty tough questions here, and you may want to even go back and provide more information for the record.

Of course, feel free to do that in response to questions. We're wanting to get as much information as we can prior to marking up this bill. So thank you very much.

Dr. DECKER. Thank you, Mr. Chairman.

[The questions and answers for the record and the statement of Dr. James Decker follow:]

SUPERCONDUCTING SUPER COLLIDER

Mr. Bevill. There has been a great deal of discussion about changes to the design of the SSC and the resulting revised total estimated cost. What is the status of the design of the SSC and what is the revised total cost?

Dr. Decker. We have decided to proceed with the Superconducting Super Collider (SSC) at the 20 trillion electron volt (TeV) energy level and to accept the Laboratory's recommendation to increase the injection energy from 1 TeV to 2 TeV and to increase the magnet coil aperture from 4 centimeters to 5 centimeters. The Laboratory is now in the final stages of preparing a site-specific conceptual design report incorporating the new design features. Based on this, a detailed cost estimate is being developed and this estimate will be carefully reviewed by the Department this summer. We expect the revised total cost to be $1 to $2 billion greater than the previous estimate of $5.9 billion.

Mr. Bevill. Dr. Bromley, the President's Science Advisor, has been quoted as saying construction of SSC cannot begin until the design of the magnetics has been proven including the testing of prototypes. What is the status of the redesign of the magnetics?

Dr. Decker. A task force formed by the SSC Laboratory is vigorously pursuing the new 5 centimeter design. It will be based on the previous 4 centimeter design, for which we have considerable experience. The scaling from 4 centimeters to 5 centimeters should be relatively straightforward, but the new design will have to be carefully checked by calculations and verified by the assembly of actual magnets. The first 5 centimeter model magnet, 1.8 meters long, is expected late in 1990.

Magnet reliability at 5 centimeters should be comparable to that at 4 centimeters. The 5 centimeter magnet may even have greater margin (higher field) than the 4 centimeter. The beam stability should be substantially improved at 5 centimeters, however, and that was the reason for the change from 4 centimeters to 5 centimeters.

We do not expect any significant difficulties in going to 5 centimeters. The Large Hadron Collider (LHC) at the European accelerator laboratory (CERN) in Switzerland is designed for 5 centimeters and some short models have been built. A 5 centimeter magnet was recently built at Lawrence Berkeley Laboratory to test SSC cable samples. Other superconducting accelerators built, or under construction, have even larger aperture: the Tevatron and Hadron Elektron Ring Anlage (HERA) magnets have 7.5 centimeter bores, while the Serpukhov accelerator (UNK) and Relativistic Heavy Ion Collider (RHIC) accelerator will have 8 centimeter bores.

Mr. Bevill. Please describe the various technical issues that have led to the need to redesign the SSC.

Dr. Decker. Two principle technical issues are responsible for the changes in the design. Since the 1986 Conceptual Design Report (CDR) both the superconducting magnets at the Fermilab Tevatron and at the Hadron Elektron Ring Anlage (HERA) accelerator now under construction in Germany were found to have a time variation of the so-called persistent currents in their superconducting cable. These currents produce a small distortion in the magnetic field which must be carefully corrected if the beam is to remain stable during the 40-minute injection process. The correction is made considerably more complicated by this time variation effect. A primary reason for increasing the injection energy from 1 to 2 trillion electron volts (TeV) was to reduce these persistent current effects (by a factor of about 3), to the level where they can be adequately corrected by small special magnets built for this purpose.

The second issue also relates to the stability of the beam during injection. At the time of the CDR, computer simulations tracked the particles for 400 turns and indicated that the magnetic field should have adequate quality for beam stability over the necessary area in the magnets. More recent supercomputer calculations track the particles for the full 10 million turns necessary at injection and indicate that some beam particles are less stable than had been suggested by the previous, necessarily more limited work. This led to increasing the magnet bore from 4 centimeters to 5 centimeters and to increased focusing of the beam (lengthening the circumference slightly to 54 miles).

Mr. Bevill. If a foreign country agrees to make a contribution to the SSC by providing the high technology components that they design and build in their country, how will the project contribute to the technical excellence of this country?

Dr. Decker. Foreign contributions to the SSC will contribute to the technical excellence of the U.S. in two ways.

First, much of the high technology equipment will be built in the U.S. and as a result, U.S. companies will gain technical excellence in the high technology fields linked to the SSC.

Second, in the case of donations, the design of technical components would have to be done either by the SSC Laboratory itself or as a collaboration between the SSC Laboratory and the donating organization. Typically, technical excellence is achieved by a sharing of ideas, concepts and experiences among internationally renown experts. The SSC Laboratory will have to be as familiar with any high technology components as the contributor so that they can be integrated into much larger systems. It should also be noted that the operation of the SSC accelerator complex itself will undoubtedly be one of the great technological achievements of the twenty-first century and that will be primarily a U.S. achievement.

Mr. Bevill. What is the status of the contribution of funds from the State of Texas?

Dr. Decker. The Department of Energy and the Texas National Research Laboratory Commission (TNRLC) have discussed the $1 billion committed in their proposal for the SSC sited in Texas. These discussions have resulted in general agreement on the proposed allocation of the funds for construction, utilities, research and development, and science education. Although a schedule for their contribution has not yet been agreed to, we are in the process of developing a Memorandum of Agreement (MOA) with the TNRLC to define responsibilities and actions necessary to implement the Texas proposal. It is intended that this MOA will include a schedule for the Texas contribution and it will be completed by about May 1990.

Mr. Bevill. When will we know exactly how much the state will contribute, when the contribution will be made, and what restrictions are imposed on the use of the money?

Dr. Decker. In accordance with the Texas proposal to site the SSC in Texas, the $1 billion of Texas funds for construction and utilities will be transferred directly to the Department of Energy. A Memorandum of Agreement (MOA) with Texas will be completed and will include a schedule and an agreed upon allocation of funds; these funds will be provided by Texas via a bond issue. Once agreement is reached on the allocation of the funds and schedule for their contribution, there will be no restriction on the funds.

It is expected that this MOA will be completed by about May 1990.

Mr. Bevill. Why is it important to build SSC?

Dr. Decker. The SSC is important to the Nation in order to continue to make progress in our scientific pursuit of the fundamental relationships between energy and mass. It is a natural extension of the long tradition in the United States of support for basic research which has provided the country with new discoveries and technologies. The SSC will allow us to probe the frontier of knowledge with cutting edge technology. In doing this, we expect spinoffs and technology transfer to help U.S. industry. By enlisting U.S. industry in the construction of this project, we expect to forge a new lasting partnership with industry. The SSC will also serve as an important resource for science education.

Mr. Bevill. What are your expectations with regard to obtaining funds from the Japanese and the Europeans?

Dr. Decker. The Europeans are busy with the initiation of the Large Electron-Positron (LEP) experimental program at the European accelerator laboratory (CERN), the start up of the Hadron Elektron Ring Anlage (HERA) accelerator at the Deutsches Elektronen-Synchrotron laboratory (DESY). and the research and development for the proposed Large Hadron Collider (LHC) at CERN. While very interested in the SSC, it may be difficult for the Europeans to make any major contributions in the near term. Italy has expressed an interest in the SSC, and I hope that they will join with us on the project in a substantial way. There is already great interest on the part of many European scientists who want to work at the science frontiers of the SSC and we expect substantial parts of the detector to be supplied by European scientists.

Japan is a likely source of non-federal contributions since they recognize the importance of basic research to technology, have expressed interest in the SSC program, and have a vigorous high energy physics community. I am hopeful that there will be substantial Japanese participation in the project and we will do our best to encourage this.

Mr. Bevill. How many full-scale magnets have been built and tested at this time? What were the test results?

Dr. Decker. Fourteen long dipoles have been built and tested. Early magnets exhibited poor quench training performance and unsatisfactory operating currents. Subsequent design modification and enhanced instrumentation and analysis diagnostics led to a successful baseline design demonstrated in six of the last seven magnets. The one unsuccessful magnet was due to poor quality control in the superconducting cable, and not to a defect of magnet design. The other magnets worked satisfactorily.

Mr. Bevill. How many more are scheduled to be built and tested prior to construction of any permanent magnets. What is the schedule for future construction and testing?

Dr. Decker. Before production magnets are built, the SSC Laboratory will build prototypes and preproduction magnets. The present plan shows 44 prototype magnets followed by 100 preproduction magnets. The exact number will depend on the experience and results obtained with these magnets.

Prototype construction and testing is currently ongoing at the laboratories and will be completed in mid-FY 1991. Industry will gain experience in assembling magnets using tooling at the laboratories in FY 1991 and FY 1992. Prototype construction and testing at industrial facilities is expected to begin in early FY 1992. Preproduction construction and testing is scheduled to start in mid FY 1993 and end in FY 1994 when construction of production magnets begins. The remaining approximately 8,000 production magnets will be built over a four year period.

Mr. Bevill. Will initiation of any site construction or initiation of any major procurements begin prior to completion of magnet development? If so, what and at what costs?

Dr. Decker. Some site construction and major procurement activity will be necessary before completion of magnet development. Some of this activity is an integral part of the magnet development and associated testing. The rest is necessary to maintain schedules for long lead-time items and activities, to begin to house staff and activities on the campus area, and to obtain a better understanding of site geology required for subsequent tunnel and other construction.

Some near-term examples would be the magnet facilities which will be constructed to provide on-site capability for magnet development and testing, and will cost about $25 million. A magnet installation and systems test facility will cost about $27 million.

State funds will be used for near-term infrastructure and other campus work will cost $24 million through FY 1991 and will permit the start of construction of on-site facilities needed to direct and control construction activities.

Among major procurements needed to assure the successful completion of the magnet development program are cryogenic systems costing $15 million, and technical components for the accelerator system string test and components for a service area and collider sector costing $15 million. In addition, long lead-time items such as Linac components costing $25 million and other injector technical components costing $15 million will be procured to assure continuous progress on the project after the magnet development program is completed.

Mr. Bevill. Does the current schedule which stretches out construction and reduces near-term budget requirements reflect a reduced commitment to the project?

Dr. Decker. No, there is no reduced commitment to the SSC project. The budget reflects the overall budget stringency coupled with the somewhat slower start seen in the first year of the project's construction phase.

Mr. Bevill. Describe the reasons for the increase in the total estimated cost of the project.

Dr. Decker. About two-thirds of the cost increase is associated with design changes. These design changes include an increased injector energy from 1 trillion electron volts (TeV) to 2 TeV, a larger collider dipole magnet aperture to 5 centimeters diameter and a larger circumference for the collider ring to 54 miles. These design changes will provide for a more reliable facility and decrease the time needed to commission the SSC. Another one-third of the cost increase is associated with updated information on items such as labor rates.

Mr. Bevill. If construction were to proceed at an optimum rate, what would the total estimated cost be?

Dr. Decker. If construction were to proceed at an optimum rate, of course the total as-spent cost would be the lowest for the project. One of the tasks we have during the next few months is to determine the optimum schedule and associated cost. Once that optimum schedule is determined, it may then be necessary to adjust for other considerations such as funding profile. We will not know the answer until we complete our review sometime this summer.

Mr. Bevill. What would be the impact of not providing new SSC construction funds in FY 1991 but continuing with R&D and design?

Dr. Decker. Appropriation of only the R&D funding in FY 1991 would have a devastating impact on the project. The present mix of Laboratory staff has been recruited with the objective of moving ahead with construction. If construction were delayed, the SSC Laboratory would lose many of the highly skilled personnel at a time critical to the cost-effective execution of this project. Curtailment of long-lead technical efforts would severely disrupt and delay the schedule. Subsequent restart of construction would surely entail delays and increased cost.

As presently programmed, the magnet industrialization program would have to be halted and the A-E/CM firm would have to be released; continuation in these areas would require appropriation of additional operating and equipment funds. Further, the availability of Texas funds in FY 1991 is expected to be contingent on the appropriation of Federal construction funds. Perhaps even more important, it would be futile to pursue foreign contributions in the face of a lack of national commitment to move forward with the SSC; many of the foreign participants would give up and become involved in projects elsewhere.

Mr. Bevill. Describe the design changes in the SSC since last year?

Dr. Decker. The major elements of the recently developed site-specific design of the Super Collider are: increased injection energy from 1 trillion electron volts (TeV) to 2 TeV, increased collider dipole magnet aperture from 4 centimeters to 5 centimeters diameter and a slightly larger circumference to 54 miles. This design, which builds on the 1986 conceptual design and takes into account all new technical information available, will enable the Super Collider to meet the energy and luminosity goals set for it with less risk and permit a shorter commissioning period.

Mr. Bevill. Have any recent breakthroughs in high-temperature superconductivity caused any rethinking of the proposed design of the SSC?

Dr. Decker. No. Even the best of these materials are still far too brittle and carry far too small a current to be useful for the SSC magnets.

Mr. Bevill. Have there been any other new breakthroughs or concepts that might alter the SSC design?

Dr. Decker. No, although as I discussed previously, recent studies of magnet persistent currents and beam stability have led to changes in the SSC injection energy and magnet bore. We know of no new breakthroughs on the horizon that might alter the design in a substantial way.

Mr. Bevill. What specific SSC construction tasks and activities are planned in FY 1990 and FY 1991? Indicate the funding of each task and justify it being Federally or non-Federally funded.

Mr. Decker. The $129 million in construction funding in FY 1990 will permit establishment of an effective SSC laboratory team, detailed design work on technical systems and conventional facilities, selected long lead technical component procurements, the start of magnet industrialization, and contracts for the first on-site support structures. Of course, no civil construction will begin until completion of the required NEPA process. Earlier interactions with the State of Texas indicated that a Texas contribution of about $80 million could be expected in FY 1990. A detailed agreement on the Texas contribution has not been reached. At present, it appears that the Texas contribution will be used largely for civil construction of the Laboratory, while the foreign contributions will be mainly in the form of technical components for the accelerator systems and for the detectors. The construction funding in FY 1991 is to support continued detailed design, the magnet industrialization program, procurement of technical systems components, on-site construction, and project management activities. The requested $169 million of Federal construction funds provide for detailed design of technical systems ($33 million); detailed design of conventional facilities ($18 million); injector system fabrication ($20 million); collider system fabrication, including support of the magnet industrialization program ($48 million); project management and support ($35 million); and site preparation, utilities and on-site structures ($15 million). The amounts indicated are the current estimates in a rapidly evolving situation.

Appropriate revisions to the FY 1991 allocations and overall project plan will be made after the new technical, cost and schedule baselines are validated. In addition, significant construction of on-site facilities and other SSC systems is expected with funds contributed by the State of Texas. Total FY 1991 non-Federal contributions are estimated to be approximately $200 million.

HIGH ENERGY PHYSICS

Mr. Bevill. Please describe the status of the Stanford Linear Collider (SLC). What has been the operating experience to date and what are the projected improvements to operations?

Dr. Decker. SLC construction was completed in spring 1987. This machine was built to accomplish two distinct goals -- to demonstrate the feasibility of the new linear collider concept and to provide data for a program of research on the properties of the Z° particle, which is the mediator of the electroweak force, one of the fundamental forces of the subatomic world. The first goal has been fully met, in that needle-thin beams of electrons and positrons have been held steady in head-on collisions for hours at a time. The second goal is now in the process of being achieved, and there has been significant progress. By the fall of 1989, more than 300 Z° particles were detected and used to make the first precision measurement of the Z° mass and width. A major scientific conclusion derived from this measurement is that the number of generations of fundamental families of particles is limited to three. As of the end of January 1990, over 500 Z° particles had been accumulated.

A potentially severe disruption occurred with the October 1989 Loma Prieta earthquake. Historically, construction at the Stanford Linear Accelerator Center (SLAC) has been at or above Federal and state earthquake standards. Therefore, damage to SLAC facilities was minimal, and the SLC has returned to operation.

There is further work needed to bring the SLC to its full physics productivity. Projected improvements to bring the SLC to its full productivity are to: (1) increase the number of electrons and positrons per bunch, (2) increase the intensity of the positron source, (3) focus the colliding beams to small cross section, and (4) polarize the electron beam strongly. The 1991 goal is to reach a production level of greater than 70,000 polarized Z° particles per year by the end of FY 1991 and to carry out an intensive program of unique research with the SLC Large Detector (SLD) during FY 1991. To do this, machine performance will be improved from the 1990 operating luminosity of about 2.4 Z° particles per hour to an effective luminosity of about 90 polarized Z° particles per hour.

The use of polarized electrons represents an extension of operating scope for the SLC which is probably not possible in the LEP storage ring at CERN and which will, therefore, allow SLAC to carry out a unique high energy physics research program with polarized Z° particles.

Mr. Bevill. What level of operation is planned for Fermilab and the Stanford Linear Accelerator Center in FY 1991? How does this compare to prior years?

Dr. Decker. The Tevatron at Fermilab is planned to be in operation in FY 1991 for about 20 weeks in the fixed target mode and about 16 weeks in the colliding beam mode. In FY 1990, the Tevatron will be operated in the fixed target mode for about 30 weeks.

It is planned that the SLC at SLAC will operate for about 36 weeks in FY 1991. In FY 1990, the SLC will operate for about 30 weeks. It is planned that the Positron Electron Project (PEP) at SLAC will operate concurrently with the SLC for about 20 weeks in both FY 1990 and FY 1991.

Overall, the level of accelerator operations for research at both laboratories would be somewhat higher in FY 1991 than in FY 1990.

Mr. Bevill. Could you characterize the proposed physics machine operating levels in the FY 1991 request? Could the proposed levels be considered as optimum levels for maximizing scientific output?

Dr. Decker. The proposed operating levels for the three accelerator facilities in DOE's high energy physics program are considered to be almost optimal for maximum scientific output for the short-term and the long-term taking into account down time necessary for accelerator maintenance and improvements.

Mr. Bevill. Describe the average facility utilization in FY 1989, FY 1990 and FY 1991.

Dr. Decker. The operating levels for Brookhaven National Laboratory (BNL), Fermi National Accelerator Center (Fermilab), and SLAC for FY 1989, FY 1990 and FY 1991 are shown in a table which I would like to insert in the record. (The information follows:)

	FY 1989	FY 1990	Request FY 1991
	(Operating Levels in Weeks)		
BNL			
Alternating Gradient Synchrotron (AGS) (high energy physics)*	20	13	14-18
FERMILAB			
Fixed Target	0	30	20
Collider	35	0	16
Total	35	30	36
SLAC			
Stanford Linear Collider (SLC)	22	30	36
Positron Electron Project (PEP)	8	20	20
Stanford Positron Electron Asymmetric Ring (SPEAR) (high energy physics)**	8	-	-
Total***	22	30	36

* AGS also operates for heavy ion physics.
** After FY 1989 SPEAR is no longer operating for high energy physics.
*** PEP and SLC can operate simultaneously. Their operating times are not additive.

Mr. Bevill. If the Japanese or Europeans have not committed to cooperation on the SSC, what are their future high energy physics plans?

Dr. Decker. While the Japanese and the Europeans have not yet committed to working on the SSC, there are strong indications that they may soon.

In the meantime, the Japanese are committed to running their current program at KEK which centers around the 30 x 30 GeV electron-positron collider TRISTAN. While there are no definite plans to build, their R&D efforts point toward a high luminosity B-factory and/or a TeV class electron-positron linear collider. These aim, respectively, at studying CP (combined symmetry of charge conjugation and parity) violation and the potential of discovery of the top quark or Higgs particle.

The European community will upgrade and double the energy of the Large Electron-Positron Collider Ring (LEP) at CERN to 100 x 100 GeV and complete construction of the Hadron-Elektron Ring Anlage (HERA), an electron-proton collider, at Deutsches Elektronen Synchrotron (DESY), Germany. Their future plans include research and development and design studies toward an ambitious and technically demanding project of filling the LEP tunnel with 10 Tesla superconducting magnets and building a high luminosity Large Hadron Collider with energies about one-third that of the SSC. Its physics potential and capabilities make it quite complementary to the SSC. Other European activities include vigorous R&D toward a TeV range linear electron-positron collider, a B-meson factory, a Tau-charm factory, and a phi-meson factory to study CP violation in the Kaon system.

Mr. Bevill. Please describe the linear accelerator upgrade at Fermilab and the need for this project?

Dr. Decker. The purpose of the Fermilab Linac Upgrade project is to increase both the intensity of the Tevatron for fixed target physics and its luminosity for colliding beam physics by a factor of approximately 1.7. This is achieved by doubling the output energy of the linear accelerator from 200 MeV to 400 MeV, which will significantly increase the particle intensities that can be accelerated through the Booster and Main Ring and into the superconducting Tevatron. The result is that there are more protons per cycle for fixed target physics and an increase in the number of both protons and antiprotons available for colliding beam physics, thus providing an extension in physics research capability and productivity.

Mr. Bevill. Why are the University Programs for Physics Research and High Energy Technology being increased so significantly?

Dr. Decker. Historically, research in high energy physics, being at the leading edge of basic research, is carried out most effectively with a very high proportion, greater than 75%, participation by university-based scientists. The university portion of the Physics Research budget is being increased somewhat to enhance the strength of university groups and allow them to participate more fully in the research activities at existing facilities while designing and preparing experiments for the SSC.

The High Energy Technology program in FY 1991 is not increased from the FY 1990 level beyond inflation.

Mr. Bevill. What accomplishments have occurred in the last year in the high energy physics field?

Dr. Decker. The most exciting results in high energy physics during the last year were the precise measurements of the W and Z^{o} masses and the decay width of the Z^{o}. Fermilab and SLAC provided the first precise measurements of their masses. SLAC gave the first determination of the Z^{o} hadronic decays and measurement of the width, which has since been corroborated and improved by more precise measurements at LEP/CERN with strong collaboration from U.S. teams. This measurement gave strong evidence that there are no further quarks and leptons beyond the three generations that are incorporated in the "Standard Model" of particles and their interactions. These new results on the W and Z^{o} bosons provide further support for the Standard Model.

Several important searches for rare processes and hypothesized particles were undertaken at BNL and Fermilab last year. A doubly weak decay of the long-lived neutral K-meson, occurring at a frequency of less than 1 part in 10^{8}, was carefully measured at BNL. Searches for additional such decays have nearly reached the expectations of the Standard Model and are subsequently setting severe limits on even rarer processes beyond the Standard Model.

The top quark continues to elude detection. The latest data, from Fermilab, show that its mass exceeds 80 GeV.

Finally, new and extensive searches for particles and phenomena that demand extensions to the Standard Model failed to uncover any such evidence, thus confirming the validity of the Standard Model.

Mr. Bevill. Please provide a brief summary including a statement of the objectives of the R&D and facility operation activities underway and planned for FY 1991 at Fermilab.

Dr. Decker. The technology R&D program at Fermilab has as its objectives support and improvement of operation of the accelerators, storage rings, and detector facilities; support of the Linac Upgrade and D-Zero Detector projects; studies and development of new technologies and concepts that will improve the future physics capability, reliability, flexibility, and cost-effectiveness of the facility; and long-range, generic detector instrumentation and technology development.

In FY 1991, highlights of the technology R&D at Fermilab include work on booster synchrotron instrumentation and accelerating and beam damper systems; studies and machine improvements leading to greater beam throughput of the 150 GeV main ring; increased antiproton source particle production; studies of and modifications to the Tevatron to shorten changeover time from fixed target to collider operation; a strong support effort for the Linac Upgrade construction and D-Zero detector projects; and studies of a new 150 GeV Main Injector as a major feature of the luminosity improvement program begun in FY 1990.

The objectives of the Fermilab facility operations for FY 1991 are to complete, by about March 1991, 8 to 10 fixed target experiments begun in early CY 1990, and then to initiate a Tevatron collider run in June 1991 at a much higher luminosity than ever before. The collider run will serve an upgraded CDF detector facility and the newly installed D-Zero detector facility beginning its first operation for physics research.

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Mr. Bevill. Please provide a brief summary including a statement of the objectives of the R&D and facility operation activities underway and planned for FY 1991 at the Stanford Linear Accelerator Center.

Dr. Decker. The technology R&D program at SLAC has as its objectives support and improvement of operation of the SLC, the PEP storage ring, and the SLD and other detector facilities; support of fabrication and testing of the final components of the SLD detector; studies and development of technologies leading to ultra high intensity operation of the PEP storage ring for $B\bar{B}$ physics; long-term R&D related to multi TeV linear collider technology; and long range generic detector instrumentation technology development directed at extending the physics research.

Highlights of the technology R&D activities at SLAC in FY 1991 include development and initial operation of polarized electron beams for SLC; raising the intensity of SLC through an extensive program of machine improvements including a new, high intensity positron target and significant efforts to reduce background in the SLC final focus system; support for the commissioning of the SLD detector and completion of final components during the first run; development and test of new radio-frequency power sources at 11 GHz and higher for future linear accelerator applications; development and fabrication of the final focus test facility to do R&D toward nanometer cross section beams; R&D on new type high gradient accelerating structures; and studies on how to operate the PEP storage ring at particle beam currents not previously considered possible.

The primary objective for facility operations at SLAC in FY 1991 is to operate the SLC as much as possible for physics studies of the Z° boson. Details of the production, properties and decay modes for the Z° particle will be measured using the new, high precision SLD detector facility.

Mr. Bevill. Describe the status of the construction of the Linear Detector at SLAC and the D-Zero Detector at Fermilab.

Dr. Decker. Both the SLD and the D-Zero Detector at Fermilab are in the final stages of construction with SLD scheduled for first operation in early FY 1991 and the D-Zero Detector by June 1991.

The SLD detector at SLAC is the first full scope detector designed specifically to take full advantage of the physics research potential of the SLC. Fabrication and assembly of SLD are nearing completion. Installation in the SLC experimental hall is scheduled for late summer 1990, and first physics measurements are scheduled for early FY 1991. Some equipment needed to fully close the measurement sphere will not be done at the time of installation in the SLC but will be retrofitted later in FY 1991. Consequently, approximately $2.4 million in funds are required in FY 1991 to complete the detector, of which $0.4 million will be provided by the Japanese collaborators.

D-Zero is a general purpose, non-magnetic detector facility for the second proton-antiproton interaction area at Fermilab. Its design emphasizes hermetic coverage and good energy and angular resolution for both electrons and muons. Construction and fabrication of the various subsystems are progressing well. Certain components have been completed, and installation of the central liquid Argon calorimeter and transition radiation detectors is underway. The schedule calls for first physics utilization in June of 1991 when the Fermilab accelerator is scheduled for the next proton-antiproton collider run.

NUCLEAR PHYSICS

Mr. Bevill. Please provide the justification for starting construction of the $400 million Relativistic Heavy Ion Collider (RHIC) during this period of significant fiscal restraint.

Dr. Decker. In its new long range plan just released in December 1989, the Nuclear Science Advisory Committee stated, "RHIC has the highest priority for new construction in the nuclear physics program. We urge a swift beginning for this important project." Even so, before including RHIC construction in our budget request, DOE ascertained that the planned RHIC funding profile could be accommodated within an approximately constant Nuclear Physics budget projection. Furthermore, the RHIC project is cost-effective since it will be built around a substantial set of support facilities already in place, including the accelerator tunnel, experimental halls, and cryogenic capabilities valued at $125 million.

Mr. Bevill. Please describe the benefits of RHIC and indicate why these benefits cannot be achieved with other machines.

Dr. Decker. By colliding heavy nuclei at very high energies, RHIC will allow scientists to recreate under laboratory conditions the extremes of temperature and density which existed in this first few millionths of a second after the Big Bang. In so doing, researchers will reproduce the hot, dense plasma of quarks--a unique state of matter which has not yet been observed, and which, as far as we know, exists nowhere else in the present universe. The Big Bang was a one-time event. In the RHIC facility heavy nuclei will collide thousands of times per second, allowing scientists to carry out fundamental experiments on the nature of matter which have not been possible in the past. Because its collision energy is a factor of ten higher than that of any existing facility, these experiments cannot be done elsewhere in the world. In experiments at RHIC, scientists will be able to map out, in microcosm, the sequence of events as a hot gas of quarks cools and condenses to form nuclear particles. These experiments will provide a new testing ground for understanding of nuclear forces and new insight into the phenomena underlying the cosmological events which brought our universe to its present state.

Mr. Bevill. Describe the impact on the nuclear physics program of delaying the construction of the RHIC by one year.

Dr. Decker. The compelling scientific case for RHIC has led the physics community to prepare for this highest scientific priority research program with great enthusiasm. The configuration, costs, and schedule for the construction project have been reviewed and endorsed by DOE in May 1987 and June 1989. The conclusion of these reviews was that the project is ready for construction. The technical readiness of the project has been underpinned by an intensive research and development program. The superconducting dipole arc magnets have been extensively prototyped, tested, and operated at fields well above design specifications. A recent review of the magnets found: (1) that the design of the magnets is appropriate for the RHIC performance specifications; (2) that the engineering design of each magnet type is satisfactory; and (3) that the magnets will be ready for industrial production with a start of the construction project in FY 1991. Because of its high research interest, demonstrated technical readiness, and full administrative preparation, delay of construction could be construed as being unresponsive to scientific priorities.

Mr. Bevill. Please describe the newly created CEBAF users group. Who belongs? How does it work?

Dr. Decker. The CEBAF users group has been in existence since the beginning of the CEBAF project and is very similar in purpose and method to users groups for other major user facilities supported by the Nuclear Physics program. The CEBAF users group consists of 720 scientists from the U.S. and around the world. This includes 473 university scientists, 197 national laboratory scientists and 50 from other types of institutions such as government and private industry. Of the 720 members of the users group, 543 are from the U.S. and 177 from foreign countries. The users group meets approximately three times a year to keep abreast of progress in constructing the facility and participate in the process of planning for the experimental program. Even closer contact with the laboratory is provided by a set of officers who are elected annually. Among the members of the CEBAF users group are the scientists who have agreed to contribute to the construction and assembly of experimental equipment for the CEBAF laboratory.

Mr. Bevill. Please provide a status report on the construction of the CEBAF.

Dr. Decker. The FY 1991 request of $65 million keeps the CEBAF construction project on cost and on schedule for completion of construction in FY 1993. A semiannual construction project cost, schedule, and management review was held September 1989 and found impressive progress. In October 1989, the DOE Advisory Panel on Accelerator Radiation Safety reviewed CEBAF plans for the three experimental end stations and reported favorably. The CEBAF Center office and meeting room complex was dedicated and occupied in October 1989. Tests of the first accelerator cryomodule were completed in November 1989. The cryomodule performed in accordance with technical specifications. The accelerator tunnel is 80 percent complete; occupancy of the injector area and approximately half of the north linac tunnel took place on January 20, 1990. The accelerator control building is now also occupied. All components of the central helium liquefier (CHL) have been delivered, and are being assembled in the CHL building. An award has been made for construction of the three underground experimental end stations. CEBAF has now accelerated the first beam through a cold cryounit to 2.5 MeV as part of the activities leading to the completion of the scheduled 5 MeV electron beam test.

Mr. Bevill. Describe how the accumulator/booster for the Alternating Gradient Synchrotron will be used for high energy physics R&D, heavy ion nuclear physics R&D, and how this facility might be used in conjunction with the proposed Relativistic Heavy Ion Collider.

Dr. Decker. The booster will provide an increase of a factor of four in the intensity of the proton beams for high energy physics research at the Alternating Gradient Synchrotron. This will permit a whole new class of experiments with high scientific merit, including more sensitive studies of rare kaon decays, to be carried out. The booster will also provide a twenty-fold increase in the intensity of polarized protons delivered by the AGS for studies of spin physics. This will permit a much more ambitious program in this area, including the possibility of multi-target operation. For heavy ion operation, the booster will permit the acceleration of ions as massive as gold (with mass of 200) for both the AGS heavy ion program and eventual injection to RHIC. This allows a dramatic increase in the breadth of heavy ion studies since, without the booster, acceleration is limited to ions no more massive than sulfur (with mass of 32).

Mr. Bevill. Provide a summary of the accomplishments of the Nuclear Physics program for FY 1990.

Dr. Decker. I would like to give an example that illustrates the way that results from very different areas go together to form a more complete picture. Until recently, measurements had shown that large atomic nuclei are almost spherical in their normal conditions. Using heavy ion beams at Lawrence Berkeley Laboratory and Argonne National Laboratory, nuclear physicists now find that nuclei can be forced into stable shapes that are more deformed than a football, and can spin at very high rates. These extreme shapes are called "superdeformed states." A theoretical determination of the additional components of the nuclear force that cause nuclei to assume these superdeformed states, will greatly extend our understanding of the nuclear force. This force must also be able to keep the nucleus from falling apart at the high rate of spin, and to keep nucleons from flying out of it like water from a spinning flywheel.

At the Bates Linac at Masschusetts Institute of Technology, an international scientific team made the first complete measurement of the charge distribution of the deuteron, which is composed of just one proton and one neutron. Here as well as in the heavier nuclei, new techniques and more precise data identified a deformed as well as a spherical component of the electric charges. This indicates that the origin of superdeformation arises in the characteristics of the fundamental nuclear force itself, and is not just due to the collective effect of bulk nuclear matter in large nuclei. Theorists are now trying to relate this non-central component of the force to the more fundamental quantum chromodynamics (QCD) theory, based on the underlying quark description of nuclear structure.

Mr. Bevill. Please provide a brief summary including a statement of the objectives of the R&D and facility operation activities underway and planned for FY 1991 at LAMPF at Los Alamos National Laboratory

Dr. Decker. Los Alamos Meson Physics Facility (LAMPF) is an 800 MeV proton linear accelerator capable of delivering up to 2 milliamperes of beam to various experimental areas. LAMPF supports as many as twelve secondary beams of protons, pions, muons, or neutral particles. The facility currently provides beam for over 50 nuclear physics experiments per year, with on-site involvement of more than 300 scientists. The Nuclear Science Long Range Plan workshop in August 1989 identified the importance of continuing a vigorous research program at LAMPF for nuclear physics program balance. Nucleon-nucleon and nucleon-nucleus programs now use a greatly improved nucleon physics laboratory including a new spectrometer, a 600 meter long neutron time-of-flight facility and intense polarized beams. The pion-nucleon and pion-nucleus programs use three established beam lines, each with distinct characteristics. Preparations are nearly complete for the Muon to Electron and Gamma experiment (MEGA) designed to observe a breakdown of the "Standard" model of electroweak interactions, an important model of subatomic physics. Precise measurements of nuclear isotopic masses are carried out on the time-of-flight isochronous spectrometer (TOFI).

Mr. Bevill. Please provide a brief summary including a statement of the objectives of the R&D and facility operation activities underway and planned for FY 1991 at the Bates accelerator at the Massachusetts Institute of Technology.

Dr. Decker. The MIT/Bates linear accelerator is a 1 GeV recirculating linear electron accelerator. The MIT/Bates facility is the major existing center in the United States for experimental investigations using an electromagnetic probe of the nucleus. The South Hall Ring Experiment (SHRE) which is now being installed will provide continuous beams of polarized electrons at 1 GeV for internal and external target experiments. When finished, the SHRE will permit experiments using the continuous beam and polarized internal gas jet targets for experiments which are outside of existing capabilities. Completion is planned for 1992. Bates operations will be reduced from 3600 to 2000 hours for research during SHRE installation. Only higher priority experiments will be equipped and run during SHRE installation, including an out-of-plane spectrometer for polarization experiments in collaboration with University of Illinois physicists.

Mr. Bevill. Please provide a brief summary including a statement of the objectives of the R&D and facility operation activities underway and planned for FY 1991 at the Bevalac at the Lawrence Berkeley Laboratory.

Dr. Decker. The Bevalac provides heavy ion beams in the energy region from 0.5 to 2 GeV/Nucleon, and is unique in the U.S. for the study of reaction processes connecting the low energy and relativistic energy regimes. About one half of the total beam time is devoted to biomedical research on cancer therapies, atomic physics, and NASA research. The nuclear physics research program emphasizes the unique capabilities of the Bevalac for studying the nuclear equation of state using a time projection chamber now under construction, mechanisms of direct production of electron-positron pairs using the dilepton spectrometer system, and exotic nuclear structures using secondary beams of radioactive nuclei. The nuclear physics research program involves the on-site presence of about 110 scientists. Ongoing improvement projects will enhance accelerator reliability, increase intensity, and provide fast beam switching to allow more efficient coordination of the nuclear physics and biomedical research programs.

Mr. Bevill. Describe the need for the Sudbury Neutrino Observatory and Gammasphere detectors.

Dr. Decker. The joint US/Canadian Sudbury Neutrino Observatory project uses an underground site for a neutrino detector located 6,800 feet below the surface in a working Canadian nickel mine to provide shielding from cosmic radiation. This detector, which contains 1000 metric tons of heavy water, on loan from Canadian authorities, and valued at $300 million, is designed for the detection of neutrinos which come from the sun. These neutrinos arise from the primary nuclear reactions by which the sun produces its energy deep within the solar core. The use of heavy water will use signals from both neutrino-electron scattering events and the unique neutrino-induced disintegration of the deuteron in the heavy water. The detector also permits the determination of the direction of the incident neutrino and its relation to the direction of the sun, or to other possible sources of neutrinos, such as supernovae.

The experiment is designed to solve the problem of why the flux of neutrinos from the sun calculated from the presently accepted model of the sun does not agree with the two flux measurements that have so far been made with less powerful detectors. Resolution of the discrepancy will greatly improve our theoretical understanding of the solar processes. By comparing the neutrino scattering and neutrino-induced disintegrations events in the detector, the measurements will also provide reliable evidence on the possibility that the electron neutrinos produced in the sun can oscillate into other neutrino types during its transit to the detector. This oscillation

would be the first evidence that neutrinos have a non-zero mass and would provide the first example of the breakdown of the standard model of nuclear forces.

Gammasphere is the proposed highly-segmented array of high-resolution detectors for measurement of gamma-rays produced in heavy-ion reactions. This detector system will enhance by a factor of one hundred the sensitivity of nuclear spectroscopy studies of nuclei at large deformation and high spins. It will provide the opportunity to examine in detail the recently discovered nuclear states of "superdeformation" and to obtain a theoretical understanding of the nuclear forces responsible for this extreme. It has the potential of literally redefining one frontier of nuclear structure physics and was given strong support by a DOE/NSF Nuclear Science Advisory Committee (NSAC) review. It is supported by a large and enthusiastic group of U.S. nuclear physicists who plan to make it the major focus of their studies for the next decade and is in an intense competition with a similar detector system (EuroBall) being planned by a consortium of European countries.

BASIC ENERGY SCIENCES

Mr. Bevill. Last year Congress provided $39,440,000 for construction of a 6-7 GeV Advanced Photon Source. Please describe the status of this project and justify your FY 1991 request.

Dr. Decker. The project has completed conceptual design and Title I design. Title II design is in progress. The Environmental Assessment has been completed. We expect site preparation work to begin this spring. Accelerator hardware is being designed and prototypes are being built. Vacuum components have been built and are being tested. The Fiscal Year 1991 request of $75,000,000 will continue the project including: design of laboratory and office facilities, site grading, major underground utilities and tunnels, construction of the utility building, injector facilities, and experimental hall substructure.

Mr. Bevill. Describe the status of the 1-2 GeV Synchrotron Radiation Source being constructed at the Berkeley Laboratory.

Dr. Decker. The 1-2 GeV Synchrotron is well underway, and we expect the facility to be ready for users in Fiscal Year 1993. Project cost and schedule are unchanged from last year and technically we expect the project will be able to deliver everything that has been promised. The user community is excited and the Department and the Congress can expect to be fully rewarded by the investment made at this facility.

Mr. Bevill. Please describe the status and budget request for an Advanced Neutron Source at the Oak Ridge National Laboratory.

Dr. Decker. The Advanced Neutron Source is in pre-construction R&D phase. This effort is directed toward resolving issues of reactor safety and critical reactor components such as the core, thermal hydraulics, neutronics, and associated facilities such as the cold source. This R&D effort will continue in Fiscal Year 1991 with a budget of $5,250,000.

Mr. Bevill. Please describe the budget and status of the Florida State University computer center.

Dr. Decker. Mr. Chairman, DOE supports part of the Florida State University computer center through a one-year extension of the cooperative agreement for support of the Supercomputer Computations Research Institute (SCRI). Wording in the report language for FY 1990 appropriations called for support of SCRI at the FY 1989 level, which was $11,900,000 before Gramm-Rudman-Hollings sequestration reductions were taken. Currently, the ETA-10G machine is being replaced by a Cray YMP 4/464 for general purpose supercomputing access. No funds are included in the FY 1991 budget explicitly for the FSU computer center.

Mr. Bevill. Please describe the level of operation of each of the national user facilities. Compare the level of operation in FY 1989, FY 1990 and FY 1991.

Dr. Decker. I will be happy to provide a table for the record which summarizes the budget and the number of weeks which the major user facilities will be operated in FY 1989, FY 1990, and FY 1991.

(The information follows:)

BASIC ENERGY SCIENCES
MAJOR USER FACILITIES
FUNDING AND OPERATING TIMES

	FY 1989		FY 1990		FY 1991	
Facility	Weeks of FY 1989 Funding	Operations Permitted	Weeks of FY 1990 Funding	Operations Permitted	FY 1991 Funding	Weeks of Operations Permitted
NSLS	$19,324		$20,119		$23,766	
VUV		30		30		44
X-Ray		30		30		40
HFBR	14,565	0*	14,749	4	23,500	48
IPNS	5,122	23	5,160	23	6,489	26
HFIR	18,977	0*	17,920	26	24,441	48
SSRL	10,152		10,437		13,981	
SPEAR		9		9		30
PEP		4**		16**		16**
LANSCE	4,800	22	4,437	18	5,700	26
CRF	3,475	52	3,619	52	4,475	52
TOTAL	$76,415		$76,641		$102,352	

* Not operating.

** Reflects parasitic time from operation of PEP by the High Energy Physics program.

Mr. Bevill. Please justify the increased funding of the national user facilities.

Dr. Decker. The increased funding requested in FY 1991 will be used to increase the availability of the facilities for users. The unusually large maintenance costs over the past several years at these facilities have been met largely at the expense of operating time. As a result, the user demand has not been met adequately. Cost increases at the High Flux Beam Reactor and the High Flux Isotope Reactor have resulted from safety demands and increased fuel costs including enriched uranium and heavy water. Costs at the National Synchrotron Light Source are going up substantially because the X-ray ring is now available for full time research operation. Costs at the Stanford Synchrotron Radiation Laboratory have gone up as a result of fluctuations in the high energy physics budget at the Stanford Linear Accelerator Center which affect the availability of the linac for injection into SPEAR. SSRL has used SLC for injection into SPEAR. With the completion of the 3 GeV injector, SSRL can operate independently of SLC; therefore, SSRL can operate for longer times and needs additional personnel to operate the 3 GeV injector. Also as High Energy Physics has assigned personnel to work on PEP and SLC, BES has had to pay for replacements for maintenance of SPEAR. As a result of these unusual increases, operating time has been reduced. Since these facilities are national facilities, it is the responsibility of DOE to assure the availability of operating time sufficient to meet the demand adequately. These facilities serve the needs of industrial researchers and university researchers as well as DOE researchers.

Mr. Bevill. Please describe your high-temperature superconducting research and development program.

Dr. Decker. The Basic Energy Sciences program in high-temperature superconductivity research and development covers: theory, to understand the mechanism of superconductivity; processing of bulk materials, to better prepare the superconductors with the optimal properties; measurements of physical and structural properties, to characterize these new materials; synthesis of materials, to uncover new systems with perhaps better properties; and thin film preparation, to form the compounds on substrates which provide better materials.

Mr. Bevill. Please highlight the status of the program and your proposed program for FY 1991.

Dr. Decker. In the area of high temperature superconductivity, basic research continues to make progress on understanding the mechanism of superconductivity of these new materials, their structure, in raising the critical current density in materials and in synthesizing new materials. Significant advances have been made with thin film materials and in the preparation of bulk materials. Other research is providing an understanding of the interaction of magnetic fields and the critical current. Research will be required for several years before any significant applications are possible because of the technical obstacles.

Mr. Bevill. Provide the FY 1989, FY 1990 and FY 1991 Department-wide budget for High-Temperature Superconducting research.

Dr. Decker. The Department-wide budget for High-Temperature Superconducting Research was $30.6 million in FY 1989, $34.3 million in FY 1990 and $43.6 million in FY 1991.

Dr. Bevill. Please describe how the superconducting materials program is coordinated within the Department.

Dr. Decker. Within the Department, coordination takes place primarily through the Energy Materials Coordinating Committee subcommittee on superconductivity. This subcommittee has representatives from all the technical organizations within DOE having an interest in superconductivity: fusion, high energy physics, conservation, defense programs, basic energy sciences, and fossil energy. This subcommittee meets to coordinate activities and exchange information. They have prepared two reports on DOE's superconductivity activities.

Mr. Bevill. Describe your program to transfer synchrotron x-ray source technology to industry.

Dr. Decker. Senate Appropriations Committee Report language for the FY 1990 budget instructed the Department of Energy (DOE) to transfer the technology of synchrotron x-ray sources from DOE laboratories to U.S. industry in about 2 years. The total cost of the initiative was set at approximately $33 million. The Senate language would allow up to $15 million to be allocated for the effort during the first year from within funds in the Basic Energy Sciences program.

On February 14, 1990, the DOE announced the program in the Federal Register to implement this guidance from the Congress. Applications are being sought from domestic, for-profit firms to design, fabricate and test a commercially reliable synchrotron x-ray source that would subsequently be used to manufacture integrated circuit chips with x-ray lithography. Two awards could be made under this initiative. Each award will be for a period of 2 years and must be matched dollar for dollar with private sector funds from the successful applicant. The deadline for the submission of applications is April 16, 1990.

DOE plans to allocate a total of $15 million to carry out the initiative. As much as $5 million may be made available from FY 1990 funds within the Basic Energy Sciences program to initiate this program in FY 1990. The Department's FY 1991 Budget request contains $10 million to complete the initiative.

Mr. Bevill. Describe your accelerated program in high performance computing.

Dr. Decker. The Office of Science and Technology Policy issued a report in September 1989, entitled "The Federal High Performance Computing Program," which describes four areas of activity in this vital subject that require some attention. In the area of high performance computing systems, we have acquired several of the newest parallel architecture computing systems, located at Argonne, Los Alamos, Lawrence Livermore, Oak Ridge, and Sandia, Albuquerque. These systems will serve as research tools to develop software and algorithms for scientific problems. In the advanced software technology and algorithms area, software and algorithms are under development for the "Grand Challenges" program begun in FY 1989 in areas such as the fundamental structure of matter, global climate modeling, structure of proteins, etc. The energy sciences network is established this year and fits in well with the National Research and Education Network activity, including most of the DOE research laboratories and universities. The basic research and human resources area of activity is continuing, and several new educational programs have begun, including the summer superkids program, postdoctoral fellowships in computational mathematics, and other programs.

Mr. Bevill. What do you consider to be the most important initiatives in the basic energy sciences area?

Dr. Decker. The Department has proposed a balanced and responsive program of basic research in the FY 1991 budget. We have included in each of the subprograms, areas of research emphasis which we feel have a high potential for payoff and are responsive to the technology needs within the Department. The FY 1991 budget in particular attempts to address the funds necessary to meet the requirements at the national user facilities supported by the Basic Energy Sciences Program. Facilities currently in operation will be fully supported in order that the capabilities at these facilities can be made available to the scientific user community at an optimal level. In addition, support of both construction and operations funding have been proposed to ensure that the two new synchrotron facilities are brought on-line in a timely and efficient way. Finally, the budget includes funds to continue the initiative in x-ray lithography in order to support the transfer of synchrotron technology to industry and funds to continue the high performance computing initiative.

Mr. Bevill. The Congress provided funding in FY 1990 to continue a program in University nuclear engineering. Please describe the status and successes of this program.

Dr. Decker. The $5.9 million available in FY 1990, reflecting Gramm-Rudman-Hollings reductions, for university nuclear engineering research and education will be used to provide continuing funding for the 37 university research projects and 10 graduate fellowships initiated in prior years. We will also support an additional two graduate research fellowships in nuclear engineering and fund 20 university reactor sharing projects. Support is also being provided to complete the National Academy of Sciences study on the future of nuclear engineering education. We believe that this program has been successful in that several innovative advanced research projects in nuclear technology have been initiated. Five new faculty members in nuclear engineering have received funding from this program and 12 students will receive doctoral degrees in nuclear engineering as a result of support from the nuclear engineering program. We expect to receive specific recommendations from the National Academy of Sciences on future needs and directions of university-based nuclear engineering programs and these recommendations will be considered in preparing future budget requests for support of nuclear engineering research and education.

Mr. Bevill. Describe the status of the Lawrence Berkeley Laboratory, the Ana G. Mendez Education Foundation and Jackson State University program to enhance computer science and scientific research. What is your program and budget for FY 1991 for this effort?

Dr. Decker. This collaborative program involving the Lawrence Berkeley Laboratory in partnership with Jackson State University, a Historically Black University and the Ana. G. Mendez Foundation which is the governing board of three private Puerto Rican colleges has been in existence since 1983. The long-range goals for this partnership have been to strengthen the education and research capabilities of the participating minority institutions and to encourage and train minority students to pursue careers in energy-related science and technology programs. Significant progress has been made since 1983 in working toward these goals. For example, in 1983 the three colleges which make up the Mendez Foundation had 36 science faculty members. Only one of these faculty members had a doctoral degree. In 1989 the Mendez Foundation schools had 55 science faculty members, twelve of whom have doctoral degrees. All the science faculty at the Mendez schools have improved their academic credentials and research capabilities as a result of their association with faculty and scientists at Jackson State University and at the Lawrence Berkeley Laboratory. Since 1983 the Mendez Foundation schools have added bachelor of science programs in biology, computer science, chemistry, applied mathematics, environmental science and industrial chemistry. New research and library facilities have been planned and constructed using non-DOE funds with technical assistance provided by Berkeley staff. At Jackson State University, faculty members have been provided with summer and academic year research appointments at LBL and remote access has been provided at Jackson State to

LBL computational facilities. LBL has also provided Jackson State on a long-term loan basis machine shop equipment, computer peripherals and scientific prototype development tools. Faculty at Jackson State are working with LBL scientists to create a new electron microscopy facility at Jackson State which can be used for both industrial and advanced scientific research programs. Students at both Jackson State University and the Mendez Foundation schools have particularly benefited from this partnership. Over 200 students have directly participated in the program since 1984. The percentage of students pursuing science and engineering degrees has increased at each institution during the past six years. Innovative precollege outreach programs have also been developed at each institution which will serve over time to increase the numbers of minority students interested in scientific and technical careers.

Our plans for FY 1991 for this program are to continue providing support using the remaining funds from FY 1990 while assisting the minority institution partners in broadening their base of support from other Federal agencies and the private sector.

Mr. Bevill. Describe your proposed initiatives in education and indicate why the Congressional initiative in nuclear engineering was dropped.

Dr. Decker. There are several expanded and new science education initiatives in our FY 1991 request all of which are directed at the Department's high priority in science education to assist in the national effort to strengthen precollege science and mathematics education, including activities for minorities and women. The expanded precollege initiatives in our FY 1991 request include increasing the number of participants in our Science Teacher Research Associates Program from 150 to 225 high school teachers, and supporting an additional 120 minority high school student research apprentices at our national laboratories. We also plan to significantly expand support for summer institutes for minority precollege students through our Prefreshmen Enrichment Program. We expect to support 3000 students in this expanded program in FY 1991. There are also several new initiatives in our FY 1991 science education program which have been developed in response to the Secretary's Science/Math Education Action Conference held last October at the Lawrence Hall of Science at Berkeley. These new initiatives include a precollege mathematics/science education program to be developed in collaboration with the Mathematical Sciences Education Board of the National Academy of Sciences and a museum-based science education program focusing on energy-related science and technology. This latter program is being developed in collaboration with the National Science Foundation and the Association of Science-Technology Centers. Our FY 1991 request also includes support for a number of national laboratory partnerships with local and regional urban and rural schools. One example of such a partnership is the collaborative effort involving the Oak Ridge National Laboratory and the Oak

Ridge Associated Universities with the Chattanooga City Schools and the Roane County/Harriman Schools in Tennessee. The purpose of this partnership will be to increase the effectiveness of elementary and secondary school science and mathematics teachers through the support of summer research internships, the preparation of instructional materials and the loan of scientific equipment. Similar partnerships are under development at all the multiprogram national laboratories and many of the program-dedicated laboratories.

As I noted earlier, our first priority in developing our FY 1991 request was to emphasize support for precollege science education. Given this priority and the resources available to use for science education support, we were not able to provide continuing support for the nuclear engineering education initiative. We expect to receive recommendations from the National Academy of Sciences on the future of nuclear engineering programs and we will take these recommendations into consideration in the preparation of future budget requests.

Mr. Bevill. Provide the proposed funding by type of all education programs underway within the Department. Provide the FY 1989, FY 1990 and FY 1991 funding.

Dr. Decker. The DOE program that provides the majority of the Department's support for science education is the Office of Energy Research (ER) University and Science Education Program (USE). The budget for the science education components in the USE Program in FY 1989 was $18.0 million; in FY 1990 the total is $18.6 million and the FY 1991 request is $20.1 million. These totals do not include the funding allocated and requested for the University Reactor Fuel Assistance Program and the R&D Laboratory Technology Transfer Program. The USE program supports university faculty and student summer and semester-length research appointments at the DOE national laboratories and funds the various precollege science education initiatives that have been discussed earlier. Science education efforts supported by other Energy Research programs include $4 million in the FY 1991 request for the Global Climate Change Program which will be used to support both graduate and undergraduate research fellowships in global climate research. Graduate research fellowships in key scientific and technical disciplines will also be supported by other ER programs and by the Office of Nuclear Energy, Defense Programs and Conservation and Renewable Energy. We estimate that about $11.6 million will be allocated in FY 1991 for the support of graduate research fellowships by these various DOE programs. Substantial funding is being proposed through the Office of Environmental Restoration and Waste Management for university and precollege programs focused on environmental remediation needs. The FY 1991 budget request for the Environmental Restoration and Waste

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Management program includes $22.7 million for the support of university research and related education programs.

It should be noted that the Department as a whole is a major supporter of university research. We estimate that approximately $454 million will be provided in FY 1991 for the support of university research. This in turn will support about 4500 graduate students working on DOE-related research.

Mr. Bevill. In FY 1990, the Congress included funds for the initiation of the Midwest Superconductivity Consortium, located at Purdue University. Please describe the status of that program and the budget for this activity in FY 1991.

Dr. Decker. We have a proposal from Purdue University for the Midwest Superconductivity Consortium, and we are in the final stages of negotiating a cooperative Research Agreement for the purpose of supporting the Consortium.

Mr. Bevill. Describe the Department's FY 1990 and FY 1991 support, upgrade and operation of the university nuclear research and training reactors.

Dr. Decker. The University and Science Education Program budget for FY 1990 includes $4.1 million for the support of university research reactors. This includes providing funding for the fabrication of fuel for university reactors and for the conversion of selected reactors to low enriched uranium as required by the Nuclear Regulatory Commission. The FY 1990 budget also includes $838,000 for the construction of a reactor facility at Arkansas Technical University. We expect to execute a grant for this purpose by September 1990. The budget also includes $1 million, less Gramm-Rudman-Hollings, for the support of university reactor instrumentation upgrades. We expect to make our selections for awards in this program by mid-April. The FY 1991 budget request for university reactors is $7.2 million. This includes $2.2 million for continued support for fuel fabrication and conversion of university reactors to low enriched uranium and $5.0 million for uranium enrichment and conversion costs. No funds are included in the FY 1991 request to support reactor instrumentation and upgrades due to other high priority educational activities.

Mr. Bevill. Please describe how the Small Business Innovation Development Act is administered within the Department. Describe the impact of this program.

Dr. Decker. The Small Business Innovation Research, or SBIR, program is managed by the Office of Basic Energy Sciences within the Office of Energy Research. An annual solicitation is issued for Phase I grant applications containing about 30 technical topics submitted by the Energy Research, Fossil Energy, Nuclear Energy, and Conservation and Renewable Energy programs. Each program contributes 1.25 percent of its extramural research and development budget to a single "colorless" SBIR fund, which in fiscal year 1990 is about $39 million.

Applications for Phase I are for early exploratory work for up to $50,000 over a period of about six months. They are subjected to a rigorous two-step review process designed to eliminate at an early stage unsuitable applications and to critically evaluate the potential winners using expert technical advice from active scientists and engineers at universities, industry, and national laboratories. Awards are made on the basis of scientific and technical merit, regardless of the technical topic under which the application is submitted. Applications for Phase II, the principal research and development effort, are for up to $500,000 over a two-year period. They are subjected to a similar rigorous evaluation and selection process.

DOE makes about 120 Phase I awards and 50 Phase II awards each year. The award to application ratio is about 12 percent in Phase I and 47 percent in Phase II.

I would like to mention that DOE is unique among Federal agencies in providing its SBIR participants the extremely important opportunity to

maintain project continuity between Phases I and II without an interruption in funding. This has been done for seven consecutive years.

In a final phase, Phase III, small businesses carry out the commercial application of the research or R&D effort with non-Federal capital. Alternatively, Phase III may involve follow-on, non-SBIR Federal contracts for products or services that the Government may need. The Department carefully monitors the commercialization process and provides its SBIR awardees assistance towards effecting commercialization of products and processes resulting from SBIR-supported work.

SBIR has had a significant impact on the Department's research programs. In almost all Departmental areas the breadth of participation by small business has significantly increased the pool of scientists and engineers now contributing to DOE research. SBIR has given the Department the opportunity to enrich its research programs, and the results of SBIR projects have been integrated into these programs. Finally SBIR has fostered effective technology transfer to the private sector and has stimulated the commercialization of products and processes developed under SBIR support.

Mr. Bevill. Please describe your program in Biosciences and provide the FY 1989, FY 1990 and FY 1991 budget.

Dr. Decker. The Energy Biosciences program of the Office of Basic Energy Sciences is devoted to discovering and describing biological mechanisms that might be employed as the basis of future energy-related biotechnologies. Clearly, studies on green plants as producers of renewable resources are a key aspect of the Energy Biosciences program. Plant productivity encompasses a broad array of processes that are integrated to form the complex entity, a terrestrial or aquatic plant. The comprehension of these component processes and their regulation is one of the major objectives of the program. Another major aspect of the Energy Biosciences program examines that portion of the microbiological world involved with biochemical transformations that yield fuels, chemicals or environmentally safe biproducts. These bioconversion processes can provide a substitute for fossil energy resources directly or through energy conserving measures in which biological mechanisms displace industrial energy inputs. In each instance, the research is aimed at understanding the fundamental mechanisms of conversion rather than a description or optimization of a process. The funding levels for the Energy Biosciences program are $20.78 million in FY 1989, $20.65 million in FY 1990, and $20.2 million in FY 1991.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

Mr. Bevill. What do you consider to be the most important initiatives in the biological research program?

Dr. Decker. For the fiscal year 1991, several important initiatives are proposed. One is the expansion of the carbon dioxide research program to develop atmospheric measurement systems to quantify the linkage between the rise of greenhouse gases and climate change as well as to accelerate the capability to model climate change at the regional level. A second is to intensify efforts in the human genome program to develop innovative, cost-effective DNA sequencing concepts, strategies and instrumentation, improve computational capabilities for manipulating, storing and analyzing huge amounts of mapping and sequencing data, address the ethical, legal, and societal implications of genome research and facilitate technology transfer. The Biological and Environmental Research program is also prepared to give increased emphasis to improving the Department's epidemiology program by establishing a Comprehensive Epidemiologic Data Resource to facilitate access to data from past and present Department of Energy contract employees by investigators. Plans are nearly complete to define mid- to long-term basic research needs on subsurface environmental processes and the role of microbes for bioremediation and waste management needs at Department of Energy sites. Additional planning is also underway to assure effective use of advanced light sources and other capital-intensive DOE facilities to maintain the nation's leadership in biomedical science and economic competitiveness in biotechnology.

Mr. Bevill. What are the principal accomplishments of the nuclear medicine program?

Dr. Decker. The Medical Applications activity, with an FY 1991 budget request of $37 million, carries out a wide range of projects to exploit energy-related technologies for biomedical uses. Over the years, the Department's research efforts have provided information that has led to the widespread use of nuclear technology in modern clinical and laboratory medicine, opening avenues of diagnosis and treatment that otherwise would not have been available. Research in FY 1991 will focus on non-invasive diagnosis and treatment techniques, development of improved instrumentation, and improved methods for studying the function and diagnosis of diseases of the brain and heart. For instance, studies using Positron Emission Tomography, commonly known as PET scans, along with radioactively labeled chemicals, have served to identify areas in the brain that are most affected by alcohol and cocaine. These studies provide information about the neurochemical mechanisms through which these substances act on the brain, and can show whether it is possible to recover from the damage that is produced.

Mr. Bevill. What steps have you taken to assure that the best and highest priority nuclear medicine programs are funded?

Dr. Decker. The nuclear medicine program has been implementing several established procedures to ensure that the best and highest priority research programs and projects are funded. The procedures include the following:

Program scope and priorities are widely circulated by a variety of descriptive written materials, such as the DOE "Guide to Energy R&D for Universities and Other Research Groups," Office of Energy Research's "Program of the Office of Energy Research," and Biological and Environmental Research's "Research in Progress - FY 1988." In selected cases, including Small Business Innovative Research, a detailed Notice of Program Interest is widely distributed.

All new proposals are subjected to peer review and at three year renewal intervals. On-site programs are periodically evaluated by site-review teams.

In October and November 1987, the Office of Program Analysis, Office of Energy Research, conducted a peer review of the nuclear medicine program. Summary results of the review have been published as a DOE report (ER-0360) and is available to the public from the National Technical Information Service. The results of the review indicate that eighty-one percent of the projects reviewed (51 of 63) were judged to be good or better. Twenty-seven projects (43 percent) were judged to be strong. Eight (13 percent) of the projects were rated as outstanding. A copy of the summary report will be provided for the record.

In January 1988, the Health and Environmental Research Advisory Committee's Subcommittee on Nuclear Medicine initiated an evaluation of program's conceptual basis, and its relationships with the nuclear, medical,

and radiopharmaceutical efforts and needs in the public and private sector. The Subcommittee's report was published in August 1989. The report concluded that "virtually all of the advances in the technology, procedures, and applications of nuclear medicine today are the direct results of research supported in whole or in part by the DOE." I will be pleased to provide a copy of this review for the record also.

More recently, a subcommittee of the Health and Environmental Research Advisory Committee has directed particular attention to the Boron Neutron Capture Therapy program. This report is expected to be available very soon.

Based on the information described previously, DOE will continue to make necessary programmatic adjustments to assure that the best and highest priority nuclear medicine programs are funded.

DOE/ER-0360

Summary Results of an Assessment of Research Projects in the

Nuclear Medicine Research Program

January 1988

U.S. Department of Energy
Office of Energy Research
Office of Program Analysis

Summary Results of an Assessment of Research Projects in the Nuclear Medicine Research Program

The Department of Energy's (DOE's) Nuclear Medicine Research program sponsors fundamental and applied research in the medical applications of nuclear and other energy technologies. Begun in the 1940's, when the Atomic Energy Commission first made radioisotopes available to medical practitioners, the Nuclear Medicine Research effort has evolved to encompass isotope and radioisotope research, radiopharmacology research, clinical feasibility research, and instrumentation research. Today, it is a major activity of the Human Health and Assessments Division (HHAD) of DOE's Office of Health and Environmental Research (OHER).

In May 1987, OHER management requested the Office of Program Analysis (OPA) to conduct a peer review of the projects of the DOE Nuclear Medicine Research program. This was done using procedures and a quantitative methodology OPA developed for assessing DOE research programs. Sixty-three individual nuclear medicine projects were reviewed by seven panels; one panel on isotopes and radioisotopes, three on radiopharmacology, two on clinical feasibility, and one on instrumentation. Each panel consisted of five to ten knowledgeable reviewers.

The purpose of the peer review was to obtain sufficient information for OHER managers to determine the following:

1. Overall quality of research in the Nuclear Medicine Research program.

2. Overall quality of research within subprograms of the Nuclear Medicine Research effort.

3. Priority research targets and opportunities for future sponsorship by the Nuclear Medicine program.

Review panels met in Bethesda, Maryland on October 13-15, 1987, and November 2-4, 1987.

Using factors and criteria defined in the OPA methodology, each reviewer gave each project appearing before his or her panel a numerical rating on the quality of science, quality of the project team, and probable impact on nuclear medicine research, development, or clinical practice. Then, applying his or her professional judgment, each reviewer chose an overall numerical rating for each project based on these factors.

Individual reviewer numerical ratings were then displayed and discussed by the panel in executive session, after which the chairman of that panel chose a final numerical rating for each project. Assisted by the panelists most expert on each project, the panel chairman then matched numerical ratings with panel comments to complete the final rating for each project.

After completing ratings of projects assigned to it, each panel was asked to identify and discuss the topics it believed were the most important for future research in the area of nuclear medicine research reviewed by the panel.

The following sections summarize panel ratings with respect to quality of the projects reviewed and briefly discuss the topics identified by the panels as the most important for future emphasis in the research program.

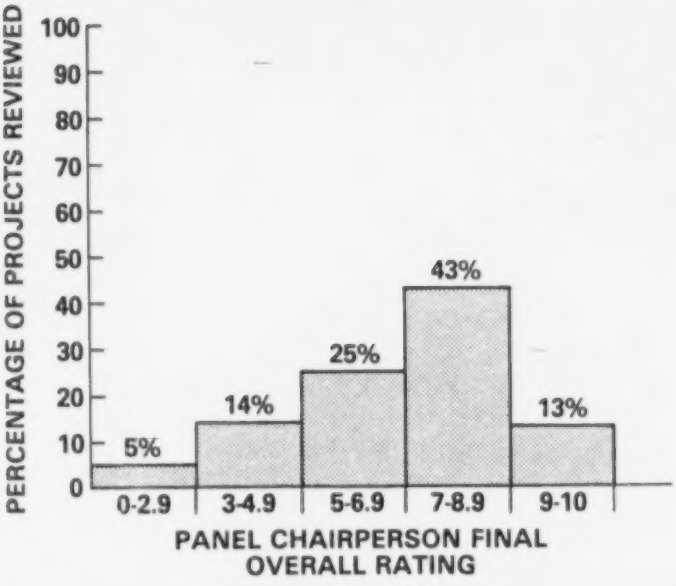
Quality of the Projects Reviewed

Individual project quality was rated on a scale from zero to ten, with numerical values corresponding to qualitative descriptors. Ratings of five to ten suggest project quality ranging from good to outstanding. Conversely, descriptors below five identify projects with deficiencies or serious shortcomings that warrant further review and management attention from DOE program managers.

Figures 1 and 2 summarize the overall ratings chosen for all projects reviewed by the seven panels. Eighty-one percent of the projects reviewed (51 of 63) were judged to be good or better; i.e., had overall project evaluations of five or higher. Twenty-seven projects (43 percent) were judged to be strong; that is, rated as a seven or better. Eight (13 percent) of the projects were rated as outstanding.

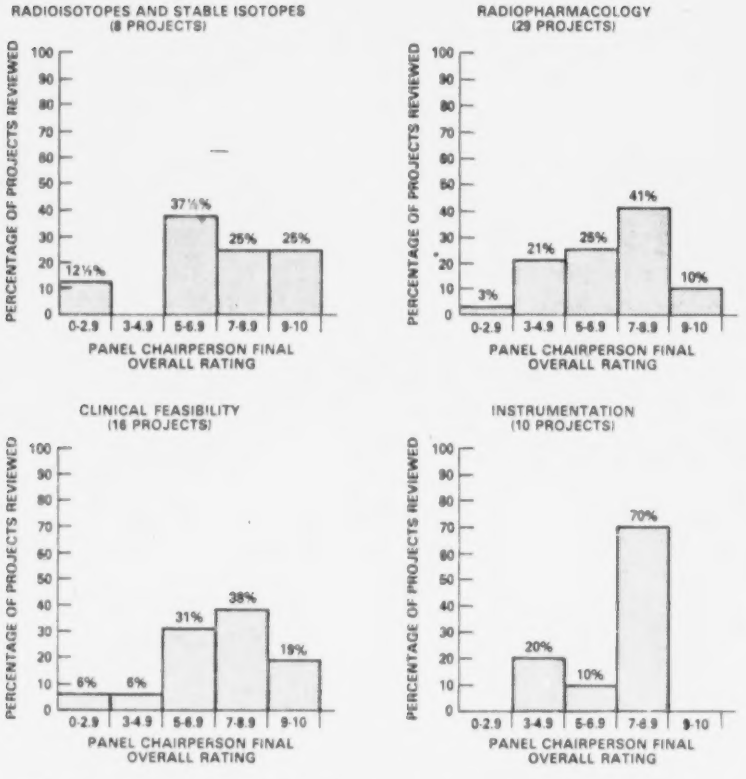
Twelve projects received overall project evaluations lower than five. The reviewers judged them to be projects with important deficiencies or major

FIGURE 1
OVERALL PROJECT RATINGS
ALL PROJECTS



NOTE: An outstanding project would rate 9-10. A strong project deserving of continuing priority support would score 7-8, while a good project with negligible important shortcomings would receive a score of 5-6. A good project with some deficiencies or concerns that should be addressed by OHER/HHAD would warrant a rating of 3-4, and a project with serious shortcomings which warrants close reevaluation by OHER/HHAD would rank 0-2.

FIGURE 2
OVERALL PROJECT RATINGS
PROGRAM AREAS



NOTE An outstanding project would rate 9-10. A strong project deserving of continuing priority support would score 7-8, while a good project with negligible important shortcomings would receive a score of 5-6. A good project with some deficiencies or concerns that should be addressed by OHER HHAD would warrant a rating of 3-4, and a project with serious shortcomings which warrants close reevaluation by OHER HHAD would rank 0-2.

shortcomings that need to be addressed by OHER program managers. Most of these projects were found to lack focus or to have inappropriate day-to-day direction. Some of these were said to be of only passable originality, others were judged to be using approaches less than state of the art, and some were noted as not following up on previous promising results. A few projects were described as having fundamental design flaws based on faulty assumptions.

Targets For Future Research

The following is a summary and synthesis of the most important future research targets and activities recommended by the seven panels for priority Federal sponsorship in the Nuclear Medicine research program.

I. Radioisotopes and Stable Isotopes

The highest three priority research objectives in the area of radioisotopes and stable isotopes are as follows:

a. Generic research on improved technology for separating and purifying stable and radioactive nuclides.

b. Expanded research on in vivo applications of nuclear magnetic resonance spectroscopy for diagnosis.

c. Low level waste disposal technology, including non-lead shielding.

2. Radiopharmacology

The review panels felt that the highest payoffs in the area of radiopharmacology would come in the following areas:

a. Basic studies in chemistry related to the inorganic chemistry of transition metals, the translations of chemistries from the "carrier added" levels of the research laboratory to the "no carrier added" levels of practical radiopharmacy, novel routes for synthesizing biologically active molecules containing short lived isotopes, ways of linking chelating functionalities to antibodies without adversely affecting the immunoreactivity of the antibodies, and fundamental studies about the biological effects of particulate radiation at the molecular level.

b. Automation of radiopharmaceutical synthesis (see instrumentation research needs below).

c. Therapy applications of radionuclides (see clinical feasibility research needs below).

d. Integration of PET, magnetic resonance imaging (MRI), computed x-ray tomography (CT) and other imaging procedures.

e. Radiopharmaceuticals for organ systems other than the brain and the central nervous systems and the cardiovascular systems, efforts to measure metabolic processes, work with

receptor binding radiotracers, and studies of presynaptic uptake processes to complete the clinical picture.

f. Long-term, stable, core support to medically oriented radionuclide production facilities, including research going beyond chemistry to produce the radionuclide and synthesize the ligand; namely, to tests in a reasonable animal model.

g. New radionuclide generating systems and, for the near term, new compounds based on the molybdenum-99/technetium-99m generators.

h. Alternate particle accelerator systems for producing radioisotopes.

3. Clinical Feasibility

Research objectives in clinical feasibility are generally defined by progress in instrumentation and chemistry programs. Success in developing a compound or an instrument creates a need for clinical feasibility evaluation, which is the link to further development through alternative funding sources.

Generally, the developmental evolution of new instruments and radiopharmaceuticals within the instrumentation and chemistry programs is insufficiently advanced to warrant their immediate support by the disease-oriented National Institutes of Health funding mechanism or by the commercial sector during further

development. The clinical feasibility component provides the resources necessary to achieve this transition--to transfer the technology--and to capitalize on the innovations derived from the basic science components.

Thus, the panels judged the highest priority of clinical feasibility research is to continue to provide appropriate means for developing promising ideas arising in the instrumentation and chemistry programs into new clinical tools.

With respect to the therapy uses of radionuclides, several specific needs for supporting research were identified as follows:

a. Radioimmunotherapy studies of the cytotoxic action associated with properly targeting to a specific tumor a radioactive isotope carried by a monoclonal antibody. Such studies would also advance standard chemotherapy and nonradioactive immunotherapy. Planning for the transfer of technology from radioimmunotherapy research is important as confidence in the success of this modality increases.

b. Putting the Radiopharmaceutical Internal Dose Information Center's data base for internal dose on a National electronic data transfer system similar to the National Library of Medicine's MEDLINE.

c. Assuring that all clinical protocols and experiments on human subjects supported by DOE supply the formal documentation required to satisfy medical ethics reviews, to formulate legally sufficient consent forms, and to obtain Independent Review Board approval. Moreover, making certain that Food and Drug Administration and Investigative New Drug requirements are complied with by these clinical projects.

d. Additional research in isotope radioimmunotherapy to learn if tumor targeting can be done without unacceptable toxicity to normal tissues in the bone marrow, liver, gut, or other vital organs.

e. Research on neutron capture therapy to solve the problems of localizing boron throughout the entire tumor, designing and constructing proper neutron delivery systems, and minimizing radiation injury to normal tissue.

f. Radiosurgery of other sites of the body; for example, the brain and pituitary gland. These are logical extensions of success realized in developing radiosurgery for arteriovenous malformations.

4. Instrumentation

The following research on instrumentation was identified as having the highest priority:

a. Single photon emission computed tomography (SPECT) imaging attenuation correction, reconstruction algorithms, and collimator design.

b. Image analysis and quantification, and two-dimensional and three-dimensional display systems.

c. In concert with the radiopharmacology area, automated radiochemistry systems for radiopharmaceutical preparation.

Other priority areas include: PET instrumentation imaging systems, magnetoencephalography system development, new photon and charged particle detectors and processors, applying high temperature superconductors to nuclear medicine instrumentation, simulation modeling of clinical applications of nuclear medicine modalities, isotopic separation, developing a whole head magnetoencephalography sensor, and a small accelerator for producing positron emitting nuclides.

REVIEW OF THE OFFICE OF HEALTH AND ENVIRONMENTAL RESEARCH PROGRAM

NUCLEAR MEDICINE

Prepared by a
Subcommittee of the Health and Environmental
Research Advisory Committee
Office of Energy Research
U.S. Department of Energy

August 1989

UNIVERSITY OF CALIFORNIA, SAN FRANCISCO

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August 16, 1989

Dr. Robert O. Hunter, Jr.
Director
Office of Energy Research
U.S. Department of Energy
Washington, DC 20585

Dear Dr. Hunter,

I am pleased to submit the report on the Department of Energy's Nuclear Medicine Program that was prepared by a subcommittee of the Health and Environmental Research Advisory Committee (HERAC) in response to a charge made by Dr. James F. Decker. The subcommittee, under the chairmanship of Dr. John G. McAfee, of the Department of Radiology, State University of New York at Syracuse, prepared the report that was endorsed by the parent committee after an extensive review process.

The report, which is quite extensive, reviewed the field of nuclear medicine and addressed the separate issues in Dr. Decker's charge. Further, it made three major recommendations that would enhance the field in the United States.

The first of these is that the United States undertake the development of a facility committed to the production of a continuous reliable supply of short-lived radionuclides for research.

A continuous supply of such radionuclides would enable the DOE to pursue several projects that the subcommittee recommends be given high priority for both diagnostic and therapeutic purposes.

Finally, the report recommends not only continued support for positron emission tomography (PET) research, but also a much greater emphasis on supporting improved design and construction of single photon emission computed tomography (SPECT) imaging devices.

Sincerely yours,

Sheldon Wolff
Chairman
Health and Environmental Research
Advisory Committee (HERAC)

SW/smb

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Preface

This report is submitted to the Health and Environmental Research Advisory Committee (HERAC) in response to a charge addressed to Dr. Sheldon Wolff, its Chairman, from James F. Decker, Acting Director, Office of Energy Research (ER), U.S. Department of Energy (DOE), dated September 18, 1987, (included in the following pages) to assess the nuclear medicine program.

The HERAC Subcommittee on Nuclear Medicine Research has summarized specific recommendations which it hopes will be helpful for planning purposes. It has reviewed the important research accomplishments in nuclear medicine in the last decade and attempted to identify fruitful areas for future research. It is hoped that this summary is a satisfactory response to the second paragraph in the charge. In essence, the Committee concludes that significant opportunities remain for continued progress in analyzing normal physiological functions and in the diagnosis and treatment of disease by radioisotopic methods. Indeed, every image produced by radionuclides reflects organ function. It is recognized that the present and future role of nuclear medicine in defining the etiology of diseases is more limited.

The report includes a summary of numerical and fiscal data for nuclear medicine and nuclear medicine research, and compares the relative role of DOE research support with that of other Federal Agencies. Answers are provided for eight specific questions in the charge. Lastly, the Committee has submitted brief comments on the targets for future research described in the assessment of research projects in the Nuclear Medicine Research Program conducted by the DOE/ER Office of Program Analysis and published January 1988.

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September 18, 1987

Dr. Sheldon Wolff
Director
Laboratory of Radiobiology and
Environmental Health
University of California
San Francisco, California 94143

Dear Dr. Wolff:

More than ten years have passed since the last in-depth evaluation of the Department of Energy's Nuclear Medicine Program. In view of the important developments that have taken place since then, particularly in the areas of instrumentation and imaging, I am writing to request HERAC's evaluation of the Program, its conceptual basis, and its relationships with the nuclear, medical and radiopharmaceutical efforts and needs in the public and private sector. This will complement a study the Associate Director for Health and Environmental Research has requested the Office of Program Analysis (OPA), Office of Energy Research, to conduct this fall. The primary purpose of their effort is to assess the quality, productivity, and mission relevance of each nuclear medicine project currently funded by the Department. Panels of experts will interview each principal investigator and draft a report of their findings before year's end. Details of the study's procedure, schedule, and panel composition will be available to HERAC to facilitate its own effort.

The OPA assessment, together with the broad overview to be conducted by HERAC, will be of great value for planning purposes. The HERAC report should, therefore, include an assessment of opportunities for analysis of normal physiological functions, as well as for the diagnosis, treatment and etiology of disease. More specifically, I would appreciate advice on the following questions:

- Is there an adequate balance between the different components of the Nuclear Medicine Program, specifically within and between the non-clinical and the clinical activities. If not, what are your recommendations to improve this situation?

- Is the on-site research effort adequately exploiting the physical and interdisciplinary resources available in DOE facilities? Are they sufficiently committed to forefront research objectives? Is the program's productivity commensurate with the resources available?

- Is there appropriate program distinction between DOE-sponsored efforts and work-for-others conducted in DOE facilities; between DOE efforts and that sponsored elsewhere by other Federal agencies or the private sector?

- Are there any research areas and opportunities that the Program should address, or should expand on? Enough to warrant the development of a major new initiative?

- Is there an adequate balance between the funding of research activities and expenditures for capital equipment and construction? If not, what would the Committee consider a proper mix under different budget scenarios?

- Are the present facilities and technologies for the development and production of new radioisotopes and radiopharmaceuticals adequate? How could these resources be improved?

- Is the input from the clinical and radiopharmaceutical sides of the nuclear medical community into the program adequate? If not, what can be done to improve this communication?

- Are the mechanisms for technology transfer of research results to application in community timely and effective? Are there undue delays between the first proof of feasibility of new applications, through proof of efficacy and safety, to clinical routine application? What does the Committee suggest to improve any shortcomings in these respects?

A response by 1 April 1988 would be greatly appreciated.

Sincerely,

James F. Decker
Acting Director
Office of Energy Research

SUMMARY OF RECOMMENDATIONS TO OHER

A. General Considerations

Historically, the original charge to OHER was the development of all nuclear technologies for biomedical applications, and these research activities became categorized as "nuclear medicine". As other nuclear technologies have appeared over the years, they have remained in this category, but the techniques and applications of these technologies now differ widely, and are relatively remote from the field of nuclear medicine. The Subcommittee recognizes that the new DOE designation, Medical Applications, includes nuclear medicine and is all inclusive in order to express the broadest aspects of what is being funded by the DOE in this category. The Subcommittee recommends that OHER should clearly separate research in nuclear medicine as usually defined from other medical applications in budgets, in peer reviews of specific research projects and in periodic overall reviews of the OHER Medical Applications Research Program. The field of nuclear medicine conventionally refers to the diagnostic and therapeutic applications of internally administered radionuclides (as unsealed sources) and diagnostic applications of radionuclides in in vitro tests of body fluids. Other currently funded research projects remote from nuclear medicine, but within the Medical Applications Program, include flow cytometry, stable isotope detectors, laser instrumentation, and detectors for non-ionizing radiation. Hence, the Subcommittee concurs that the term "nuclear medicine" should not be used for all medical applications of nuclear technology. The charge to the HERAC is to evaluate the DOE's Nuclear Medicine Program and, therefore, except for a discussion of numerical and fiscal data, this report deals only with Nuclear Medicine as defined above, a subcategory of Medical Applications.

B. Nuclear Medicine Status

Nuclear medicine research is conducted in five principal areas: stable isotope research, radioisotope development, radiopharmaceuticals, instrumentation, and clinical feasibility. Specifically, current DOE supported nuclear medicine research is directed to the development of new and improved radiolabelled tracers, the development of high resolution PET and SPECT procedures, the refinement of imaging instrumentation, the development of effective approaches in delivering radiation therapy to cancer sites and clinical feasibility studies to determine the efficacy of new nuclear medicine procedures in the clinical setting. The multi-disciplinary research of the DOE nuclear medicine research program is supported by the expertise of physics, chemistry and medicine, and is transferred rapidly to clinical practice not only in nuclear medicine, but in the many other fields of medicine including neurology, cardiology, oncology, hematology, gerontology, endocrinology, orthopedics, gastroenterology, nephrology, pulmonology, radiation therapy and general surgery and the various surgical sub-specialties.

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The discipline of nuclear medicine has become a significant contributor to health care in the United States. Examinations by means of radioactive tracer methods are of great importance in the diagnosis of abnormalities and diseases of the lung, heart, liver, gall bladder, spleen, kidneys, brain, blood vessels, skeleton, and thyroid gland. Imaging of the skeletal system, for example, provides the earliest and most sensitive indication of a pathologic lesion in bone of any diagnostic method routinely available today. This nuclear medicine test is useful in both hospitalized and non-hospitalized patients, and is an important early indicator of cancer that has spread to bone. Therefore, this test is important in the planning, execution and evaluation of therapy in patients in whom the diagnosis of cancer has been established.

Nuclear medical techniques are also used to determine specific physiological functions. Such examinations include, for example, measurements of cardiac output, thyroid function, and vitamin, fat, and mineral absorption from the gastrointestinal tract.

In vivo diagnosis is carried out with small amounts of radioactivity that are administered to the patient, followed by external measurements to image an organ or the internal distribution of the administered drug. In vitro studies involve an analysis of a blood or urine specimen for a specific component, using a radioactive substrate.

National statistics indicate that about one in three of all hospitalized patients in the United States are treated with or have a diagnostic test that utilizes some form of nuclear medicine. Since their introduction in routine medicine practice during the 1950s, nuclear medicine testing using radioactive tracer studies have become widely accepted and have evolved from the simple measurement of the per cent uptake by the thyroid gland of an oral administration of Na I-131 to measuring how the living human brain functions and how the brain biochemistry is altered in mental illnesses such as depression, schizophrenia, Alzheimer's disease and Parkinson's disease. Nuclear medicine techniques have localized and quantified normal mental processes such as emotions, fear, anxiety and differing cognitive activities, as well as violent and aggressive behavior.

The widespread application of nuclear medicine is shown by the fact that about 17 million in vivo, including approximately 8 million scans, and 100 million in vitro nuclear medicine studies were performed during 1985. This corresponds to about one out of every three hospitalized patients plus a large number of outpatients (today more than 50 per cent of all nuclear medicine tests are administered to non-hospitalized patients) for whom the diagnosis and management of disease relies heavily on the results of radiotracer studies. Clearly, this discipline has evolved to the point where it affects a large segment of the public. If the clinical indicators for requesting nuclear medicine examinations are related to the requests for laboratory and radiologic testing, then approximately one-third are obtained in order to help make a diagnosis, one-third to evaluate response to therapy and the remainder to record the objective temporal changes of a disease process.

Perhaps one of the most exciting new technologies developed through DOE support is positron emission tomography (PET), a diagnostic technique with unique capabilities for imaging regional function and biochemical reactions within various organs of the living, awake human body. [Because there are relatively few PET centers in the United States at the present time, it is important that DOE support be provided to develop and refine single photon emission computed tomography (SPECT), a technology that follows the same general principles as PET, but which is much less expensive and can be readily available in most nuclear medicine departments across the country.] Using PET (and SPECT), it is possible to differentiate cells that may look normal under the microscope but that function abnormally. Since it is well recognized that chemical changes often precede structural changes in the course of a disease, PET (and SPECT) scanning, therefore, permits earlier detection of disease than is available from any other imaging technology, thereby potentially saving millions of health care dollars.

The numbers of people suffering with various brain disorders are enormous. A National Institute of Mental Health survey has stated that 20 per cent of all Americans have a mental problem during any six-month period. Half a million Americans suffer a stroke each year resulting in a hundred and fifty thousand (150,000) deaths, the third leading cause of death for all Americans and leaving as many as two million Americans alive but disabled from a previous stroke. There are two to three million Americans who suffer from epilepsy, approximately eight hundred thousand with Parkinson's disease, eleven million with panic and obsessive-compulsive behavior, and as many as thirteen thousand a year develop a primary brain tumor.

Alzheimer's disease has probably the largest affect on the health, social and economic lives of the elderly in this country. This disease is the fourth leading cause of death in the elderly, killing approximately 100,000 patients a year. This disease affects no less than 15 percent of our population greater than sixty-five years of age; severe dementia affects ≥ 5 percent and there is mild to moderate dementia occurring in another 10 percent. The disease incidence is increasing; there were approximately 500,000 patients with Alzheimer's disease in 1975 while there are 2.5 million today. Because of the aging of the population, the National Institute of Aging has extrapolated these data to predict that there will be four to five million patients with Alzheimer's disease by the year 2030. This disease is the major cause of nursing home confinement in the United States; the estimated cost for this care during the year 1982 exceeded $6 billion.

It is widely accepted that virtually all of the advances in the technology, procedures and applications of nuclear medicine today are the direct results of research supported in whole or in part by the DOE. To illustrate the importance of a continuing high-level of research funding in this program, this report will focus on a few examples of nuclear medicine research that undoubtably will become tomorrow's clinical practice, improving greatly our ability to diagnose and treat disease.

C. Specific Recommendations

1. As a major initiative, the Subcommittee proposes the development of a facility containing a cyclotron or other suitable charged particle accelerator for the continuous production of radionuclides for research as a national resource. The DOE-supported facilities (chiefly at Brookhaven and Los Alamos National Laboratories) are the sole sources for many radionuclides for all of biomedical research in the U.S. Because their accelerators operate only during experiments under the control of high energy physics, radionuclide production is a secondary intermittent activity with long periods of shut-down. Consequently, biomedical and nuclear medicine research becomes intermittent, particularly with short-lived radionuclides. This will become a greater problem in the future because of progressively increasing application of these short-lived radionuclides at both research and clinical levels. A continuous reliable supply of research radionuclides is available in western European countries and Canada. The Subcommittee believes that this is a worthy goal for the U.S. also, but can be reached only by establishing a facility committed to radionuclide production. The Subcommittee did not consider the important operating specifications for such a facility including the physical and engineering aspects. The major specifications were discussed at a special meeting at the Los Alamos National Laboratory, August 16-17, 1988.

2. If the above-mentioned goals of continuous production of radionuclides for research can be achieved, projects of high priority should include the following:

   (a) greater exploitation of short-lived radionuclides for diagnosis

   (b) trial of various radionuclides theoretically optimal for radiation therapy

   (c) exploration of novel gamma-emitting radionuclides for incorporation into diagnostic radiopharmaceuticals, and

   (d) further development of generator systems for ultra-short-lived daughter radionuclides.

3. In addition to continuing support for PET research, DOE should place a much greater emphasis on supporting improved design and construction of SPECT imaging device than in the past. Such instrumentation would become widely used at the community level, taking advantage of the variety of gamma-emitting radiopharmaceuticals already available. In recent years, it has become apparent that many lesions missed on planar camera images are detectable by SPECT. However, industrial development has been limited largely to rotating single scintillation cameras, with inherent low photon detecting sensitivity. Fundamental improvements in detector arrays are needed to increase sensitivity.

4. Support for new radiopharmaceuticals should be increased because many approaches for their development are coming close to fruition. In diagnosis, these include new Tc-99m agents for imaging the heart and brain which will eventually play an important role in the diagnosis of such common conditions as coronary artery disease and stroke. After a period of slow progress, research in labeled monoclonal antibodies for both diagnosis and therapy is now showing encouraging results. This approach has great potential for targeting radionuclides in vivo to specific cell types and specific tissues, and the technical problems of this complex technique gradually are becoming resolved. Other radiopharmaceuticals recently designed for radiation therapy look promising. Because of the increasing regulatory requirements before initiating human trials of new radiopharmaceuticals, their development will require larger budgets than in the past.

NUMERICAL AND FISCAL DATA RELATED TO NUCLEAR MEDICINE AND NUCLEAR MEDICINE RESEARCH

The DOE budget for Medical Applications of Nuclear Technology from FY 83-88 (Figure 1) shows little if any growth through 1987. The major categories in this budget include production of radionuclides, stable isotope application, radiopharmaceutical development, feasibility for medical applications, radiotherapy research and imaging devices and detectors. This budget includes other applications of nuclear technology besides nuclear medicine such as the applications of stable isotopes, radiotherapy research with external beams of protons, neutrons and heavy ions and instrumentation research with lasers, flow cytometry and detectors for non-ionizing radiation. In the itemized DOE budget for FY 87 (Table 1) these projects are separated from the categories of conventional nuclear medicine. The total budget for nuclear medicine, as conventionally defined, was 17.9 million dollars. Out of the sharp increase in the FY 88 budget of about 12.4 million dollars, 9.9 million is earmarked for a mandated specific project in neutron capture therapy (not in nuclear medicine per se) and 3 million for competitive projects to expand research in immunoconjugates. Of the 28 cyclotron-PET facilities in the USA, DOE supported at least some of the research of 14 centers in FY 87. Compared with this, the support for radiopharmaceutical development and imaging devices and detectors for other gamma-emitters and radionuclide therapy was relatively modest. In the medical application feasibility budget category, it is interesting that a sizeable number of clinical studies were performed with positron emitters, whereas most of the projects with other radionuclides were studies in experimental animals.

The corresponding NIH research budget for extramural programs in nuclear medicine in FY 87 is listed in Table 2, totalling 45.2 million dollars. Of this, 23.5 million were expended on research with positron emitters, 20.1 million on research on other radionuclides and the remaining 1.5 million on stable isotopes and novel detectors. The expenditure for development of instrumentation was relatively small for gamma emitters compared with positron emitters. In the imaging category, brain studies predominated PET imaging, whereas imaging with labeled monoclonal antibodies predominated the research with gamma emitters. Therapeutic applications of radionuclides and dosimetry accounted for only 5% of the total budget.

The Veterans Administration budget for nuclear medicine research totalled 1.59 million dollars in FY 87, gradually increasing from 1.0 million in FY 82. However, some projects in MRI and radiation biology were included in this budget; the budget for conventional nuclear medicine research was 1.36 million. Other agencies of the Federal Government, such as the Department of Defense, also provide some support for nuclear medicine research. Non-governmental agencies, such as the American Cancer Society and the American Heart Association, also contribute some support.

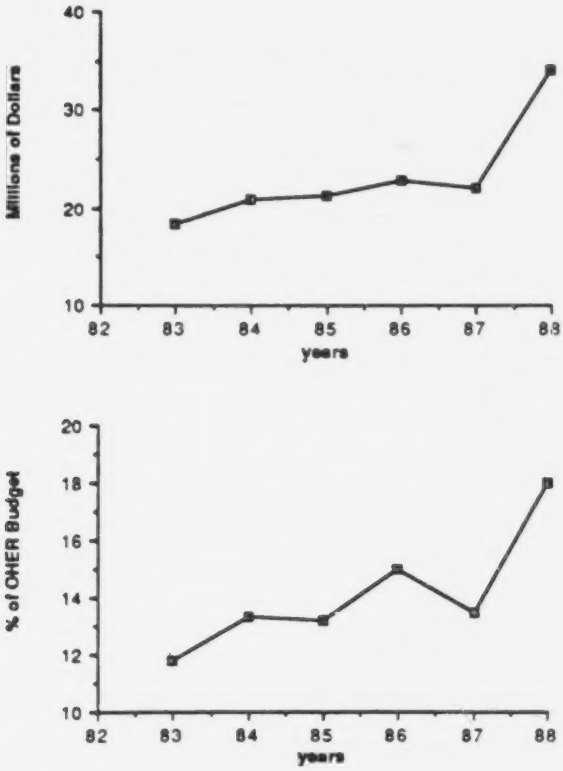
Complete data on the clinical utilization of nuclear medicine procedures from year to year are not available. However, estimates for diagnostic imaging procedures in hospitals in the USA in 1985 are summarized in Table 3. In that year, nuclear medicine procedures represented about 4.4 percent of all imaging studies, CT and MR 4.9 percent and ultrasound 6.7 percent.

The health care costs in nuclear medicine and other radiological procedures for 1987 and projected for 1989 in the USA are summarized in Table 4. The Federal support for research in nuclear medicine (DOE, NIH, and VA) of 64.4 million dollars represented 6.4-8.5 percent of total health care costs in nuclear medicine in 1987. From the 1987-88 SCARD survey, the total budget of the average academic radiology department was 7.27 million dollars, of which 1.08 million (14.8 percent) was used to support research.

Manpower in Nuclear Medicine

Information on the manpower available for the conduct of clinical nuclear medicine procedures in the USA is incomplete. The American Board of Radiology certified 8,850 candidates in diagnostic radiology from 1977 through 1986 and 1,045 in 1986. The same Board certified 588 candidates with Special Competence in Nuclear Radiology in the same decade, but only 20 in 1987. Candidates certified by the American Board of Nuclear Medicine total 3,502 since its inception in 1972, 702 candidates in the last decade and approximately 80 per annum in recent years. An unknown number of physicians has been certified by both the American Board of Radiology with Special Competence in Nuclear Radiology and the American Board of Nuclear Medicine. Certification in all medical specialties in the last decade was obtained by 170,000 physicians. Hence, it appears that a maximum of only 0.75 percent of all medical specialists have obtained special training in nuclear medicine. The membership of the Society of Nuclear Medicine in 1987 listed 4,114 physicians and 802 Ph.D. members, and the membership has increased about 2.5 percent per annum in recent years. From the available data, it may be assumed that a large number of physicians without extensive training in nuclear medicine are involved in the conduct of clinical nuclear medicine procedures.

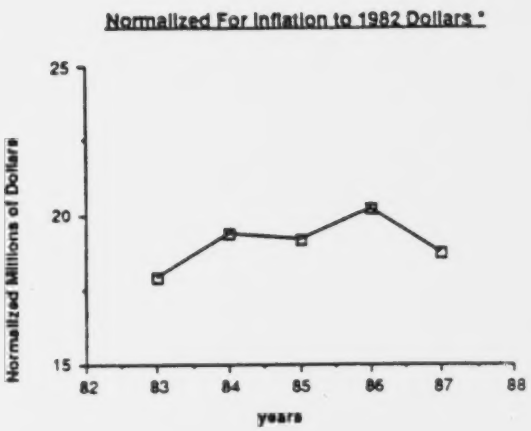
DOE Budget For Research In Medical Applications of Nuclear Technology



(budget for research only, excluding program direction, capital equipment and construction)

Figure 1

DOE Budget For Medical Application of Nuclear Technology



* Bureau of Labor Statistics annual inflation %, based on consumer index average for U.S. cities
'83-2.9%, '84-4.2%, '85-3.2%, '86-1.5%, '87-4.5%

Figure 2

Table 1.

DOE Budget for Biomedical Applications of Nuclear Technology FY 1987
(In thousands of dollars, number of projects/facilities in parentheses)

	Positron emitters	Other radionuclides	Total
Radionuclide production	240(1)	2,225(3)	2,465(4)
Stable isotope production	?	?	480(2)
Radiopharmaceutical development	5,297(17)	2,560(17)	7,857(29)
Imaging devices and detectors	2,357(6)	348(1)	2,705(6)
Medical application feasibility	1,747(7)	1,448(4)	3,195(9)
Radionuclide therapy	0	360(1)	360(1)
Misc. nuclear medicine	-	-	856(4)
Total nuclear medicine	9,641(31)	6,941(25)	17,918(55)
Other radiotherapy research			2,110(7)
Other applications of technology			2,250(9)
Projects other than nuclear medicine			4,360(16)
TOTAL BUDGET (as known in October, 1987)			22,278(71)
Total for "extramural" research projects at University Centers			5,685(approx.)

This listing does not include awards to specific institutions mandated by Congress without peer review.

Table 2.

NIH Research Budget for Nuclear Medicine FY 1987 for Extramural Programs
(as of 11/11/87, direct and indirect costs, includes R01 grants, contracts, program project grants, cancer development, cooperative clinical research, new investigator, outstanding investigator, research career development, specialized center, comprehensi center, academic teacher, general clinical research center, biotechnology resource, clinical investigator and small business awards; in thousands of dollars)

	Positron Emitters	Other Radionuclides	Total	% of Total*
Radionuclide production	-	0	0	0
Stable isotopes/resource Los Alamos	?	?	753	2
Radiopharmaceutical development	3,654	6,373	10,027	22
Imaging devices, detectors, facilities	5,066	2,620	7,686	17
Novel instruments and detectors	?	?	791	2
Imaging - brain	10,706	286	10,992	24
- heart	2,857	1,935	4,792	11
- monoclonal antibody	0	4,285	4,285	9
- other tumor methods	1,259	658	1,917	4
- all other organs	-	778	778	2
Imaging subtotal	14,822	7,942	22,764	50
Non-imaging in vivo studies	0	133	133	0.3
In vitro and autoradiographic studies	0	499	499	1
All support, non-therapeutic applications	23,542	17,567	42,653	94
Therapeutic applications and dosimetry	0	2,431	2,431	5
Epidemiology	0	102	102	0.2
	23,542	20,100		
Total			45,186	100

*percentages do not add to 100 due to rounding

Table 3.

Diagnostic Imaging Procedures in the USA in 1985 (Hospitals only)

(National Institutes for Health Care Statistics)

	Annual Imaging Procedures	% of Total
All	170M	100
Nuclear Medicine	7.4M	4.4
CT and MR	8.3M	4.9
Ultrasound	?	6-7

US population in 1985 238,740,000

Table 4.

Health Care Costs in USA

		1987 Billions of Dollars	% of Total	Projected 1989 Billions of Dollars
(1)	Total	454	100	490
(2)	All imaging	8-11.3	1.8-2.5	9.7 12.2
(3)	Radiation Oncology	2.3	0.5	2.4
(4)	Imaging & Radiation Oncology	10.3-13.6	2.3-3	12.1 14.6
(5)	Nuclear Medicine only	.76-1.0	7.4 of (4)	.89 1.08
(6)	Radiopharmaceuticals	.126	-	-
(7)	Nuclear instrumentation	.199	-	-

Sources (1) through (4) American College of Radiology
(5) estimated from gross hospital and professional billings
(6) and (7) Frost and Sullivan

IMPORTANT ADVANCES IN NUCLEAR MEDICINE OVER THE LAST DECADE RESULTING FROM DOE RESEARCH FUNDING

A. PRODUCTION AND AVAILABILITY OF STABLE AND RADIOACTIVE NUCLIDES

The development of nuclear medicine has closely paralleled the availability of radionuclides with suitable nuclear and chemical properties. The most important radionuclide clinically has continued to be Technetium-99m because of its favorable nuclear characteristics and ready availability at low cost. The chemistry of Tc-99m received particular attention during this period, and a number of specific radiopharmaceuticals are beginning to emerge as a result. Current efforts are providing the nuclear medicine community with better imaging agents for heart, brain, and other organs. The parent, Molybdenum-99, is routinely available from the Atomic Energy of Canada, Ltd., and domestic sources account for a much smaller fraction. Fission-produced Mo-99 is exclusively utilized in the generators; production of Mo-99 by neutron activation has become obsolete. The original development of the Mo-99/Tc-99m generator system, and most of the initial work on the Tc-99m radiopharmaceuticals accomplished at the Brookhaven National Laboratory was supported by the predecessors of DOE. Without such support, this important development would not have been possible. Over the past decade, its use has grown steadily. Presently, more than 80 percent of all diagnostic nuclear medicine procedures in the U.S. are performed with Technetium-99m.

Radionuclides of iodine continue to be used for various applications. I-131 and I-125 are readily available from commercial sources. I-131 remains the radionuclide of choice for the therapy of hyperthyroidism and differentiated thyroid malignancy. It is only marginally suitable for imaging and non-thyroid applications, yet still enjoys widespread popularity. Most clinical therapeutic trials and imaging with monoclonal antibodies utilize I-131. The chemistry of iodination is well-understood and this radionuclide is available routinely at moderate cost. However, considerable effort has been expended to select more suitable radionuclides and determine the feasibility of their production for monoclonal antibodies and other agents. The chemistry of labeling antibodies with Tc-99, and In-111 has already met with some success.

Iodine-123 has excellent nuclear properties and is an almost ideal nuclide for imaging. However, in some applications, radioimmunoimaging, for example, its usefulness is limited by its short half-life. Unfortunately, no longer-lived "parent" radionuclide exists, so that it is impossible to devise a generator like the Mo-99/Tc-99m system. I-131 appears to be an optimum label for receptor binding tracers, brain localizing amines and certain kidney agents. It labels compounds whose in vivo function is not maintained after labeling with radiometals such as Tc-99m. The supply and demand situations for I-123 remains a paradox, however. Despite all of its advantages and the interest of the nuclear medicine community, a successful production and distribution of I-123 for research has not materialized so far. The production of pure I-123 by the p,5n reaction requires a high energy cyclotron and, thus, is expensive. Due to its relatively short half-life of 13 hours, its distribution on a regular basis is a major

problem. I-123 is regularly and abundantly available for clinical and research uses in Japan and western Europe. The major source of pure I-123 in this country is a Canadian radiopharmaceutical company.

Many other radionuclides have found applications in nuclear medicine. They have fulfilled intrinsically important research and clinical needs. Among these, the applications of Tl-201, In-111, Ga-67, Xe-133, Xe-127 and Rb-82 are well established. Recently developed Tc-99m myocardial agents, however, may partially replace Tl-201. These nuclides except Xe-133, Xe-127 and Rb-82 are produced in low energy cyclotrons and are available commercially. The costs, however, are progressively increasing. Xe-127 is produced by a high energy reaction at BNL and LANL. The supply has barely met the demand. Because LANL recently stopped producing Xe-127, the situation will become much worse and will have to be addressed. Other useful radionuclides include Cr-51, P-32, Co-57, Se-75, Fe-59, Ru-97, Pb-203, Gd-153, Au-195m, Au-198, Cu-67, Re-186, Re-188, Ir-192 and short-lived positron emitters.

With the advent of monoclonal antibody technology, special interest has been devoted to therapeutic nuclides. Even though the process of the selection of ideal nuclides for radioimmunotherapy has only recently begun, several radionuclides are already emerging as promising candidates. Examples are Sc-47, Cu-67, Sm-153, Rh-105, Au-199, Y-90, Pd-109, Re-186, and Re-188. The results with most of these are preliminary. The ones that have received most serious consideration thus far are Cu-67, Y-90, and Re-186. With parallel developments in antibody-labeling chemistry and in the selection of better antibodies, many of the above radionuclides will be investigated in detail. Their production and availability will have to be addressed.

Production facilities other than Brookhaven and Los Alamos National Laboratories are operated by industry. However, most commercial cyclotrons have limited capabilities for producing certain long-lived radionuclides, and others that require energy accelerators for efficient and economical production.

Reactor production of radionuclides has been limited primarily to ORNL. The High Flux Reactor at ORNL, however, has been shut down since November 1986 and it is not known when it may start up again. Research quantities of many isotopes have been available from other reactors, but large scale or economical production has been hampered by their relatively low fluxes.

The stable nuclides have been enriched by the Calutrons and other isotope separators at ORNL, LANL and Mound Laboratories. Recent interest has focused on O-18, Ca-48, S-33, Zn isotopes and a number of He, N and C isotopes. The supply for most other stable nuclides has been sufficient to meet the demands of research investigators. However, age, poor reliability, and limited capabilities of the ORNL isotope separators are creating a serious problem.

B. RADIONUCLIDE DETECTORS AND IMAGING SYSTEMS

B.1 PET and Associated Cyclotrons

Positron emission tomography (PET) is a nuclear medicine technology which has now reached a degree of maturity where it is possible to assess, with a good level of confidence, important directions in its future development. In broad terms, PET imaging consists of (1) the administration of a selected compound labeled with a positron-emitting radionuclide to a patient followed by (2) imaging the distribution of the positron activity as a function of time and space by positron emission tomography, and finally by (3) eliciting from these data, through the application of a suitable model, an understanding of the biological handling of the compound. The usefulness of PET in biomedical research and clinical applications stems from three foundations: (1) the desirable chemical properties of a relatively small number of short-lived radionuclides, particularly Carbon-11, Oxygen-15, Nitrogen-13, (the "physiological radionuclides") and Fluorine-18; (2) these radionuclides decay by emission of positrons resulting in annihilation photons which render their in vivo imaging particularly effective; and (3) the application of the tomographic reconstruction process from radioactivity measurements (projections) taken at different angles around the subject being imaged.

The development of PET as a useful tool in nuclear medicine spans at least three decades. The progress in development of PET initially was slow because it is a complex, difficult technology which requires the creation of many components crucial to its effective function. Most of the important radionuclides in PET have such a short half-life that they must be generated on site, by irradiation of suitable targets by ions, usually in a cyclotron. Cyclotrons are expensive, complex instruments; consequently, their acquisition by biomedical research centers is slow. The utilization of these short-lived cyclotron-produced radionuclides requires their incorporation into metabolically important molecules. While the labeling of some of these molecules is simple (O_2, H_2O, CO, CO_2), others challenge the ability of the best radiochemists.[2] In fact,[2] in earlier years, PET was limited by the availability of suitably labeled compounds. However, imaginative chemists have later succeeded in labeling several hundred biomedically useful compounds with these "physiological" radionuclides. Hence, the availability of labeled molecules is no longer an impediment to the progress of PET. Nonetheless, the continuous addition to the PET pharmacopoeia is a most important component in the healthy growth of this modality.

The detection of the annihilation radiation, upon which PET depends, also underwent a relatively slow, but highly effective development. In earlier days, the radiation was detected by scintillation probes located strategically over the organ to be imaged. Different types of cameras also were used. Tomographic reconstruction of the images in the early 70's provided a new impetus to this technology. The early systems were inefficient and had relatively poor spatial resolution. As a result of progress in the past fifteen years,

modern PET devices, including most commercial ones, provide images suitable for a number of biomedical studies which cannot be carried out by any other modality.

The armamentarium needed for PET studies can be divided into three categories: (1) the accelerator and ancillary equipment for the generation of the required radionuclides; (2) the radiochemistry systems needed for the incorporation of the radionuclides into radiopharmaceuticals; and (3) the imaging device for acquiring data and reconstructing the PET images. Other ancillary tools and instruments in PET studies include radiopharmaceutical delivery systems, computers and work stations for data analysis.

B.2 Evolution of Cyclotrons and Imaging Devices for PET

The ions adequate for the preparation of PET radionuclides in sufficient quantities and in convenient chemical form for PET studies are protons with energies around 15 MeV and deuterons of 7 MeV, with currents on the target of approximately 50 μAmps. Several centers, however, have opted for accelerators of high energies. On the other hand, there have been reports claiming that protons accelerated to about 11 MeV were sufficient for the production of adequate amounts of all PET "physiological" radionuclides.

These high energy ions may be produced and accelerated in linear accelerators, Van de Graaff accelerators, cyclotrons, or other accelerators. Cyclotrons, however, have been most suitable for this purpose. Initially, cyclotrons designed for physics experiments were borrowed for the generation of PET radionuclides. However, with the growing interest in this physiological imaging modality, commercial companies produced "small cyclotrons" specifically designed for the production of PET radionuclides. By and large, these machines were of conventional design but their performance was optimized for convenient, reliable operation required for the routine preparation of radionuclides. Now, some commercial machines are offered in a self-shielded configuration to reduce the cost and space requirements for radiation protection. One company offers a machine accelerating 11 MeV protons as negative ions in a self-shielded configuration. The lower energy protons and the negative ion acceleration reduce the undesirable neutron fluxes. This design was adopted by the manufacturer for the purpose of reducing the radiation protection requirements.

In the early 70's radiation detectors of the PET imaging devices were thallium activated sodium iodide scintillation crystals. These early devices imaged only one section of the body at a time, with a spatial resolution of approximately 2 cm. More recently newer scintillation crystals were incorporated into PET machines. These included bismuth germanate, barium fluoride, cesium fluoride, and gadolinium orthosilicate. The creation of these crystals was largely stimulated by PET. More modern machines produced a larger number of slice images simultaneously, higher resolution (approximately 2.6 mm in experimental systems) and fast reconstruction times. Photon time-of-flight systems reduced the signal-to-noise ratio. These

advanced imaging devices were developed by the DOE Laboratories, academic community as well as by industry. With the current state-of-the-art in the U.S., PET produces good quality images with performance characteristics not far removed from fundamental physical limitations. PET instrumentation is still not optimum. The advances expected are in detector sensitivity, resolution and image processing computer science.

B.3 Planar Scintillation Cameras.

Planar scintillation cameras have become mature instruments, now universally used in clinical nuclear medicine. Approximately eight years ago, the incorporation of digital electronics resulted in improved spatial resolution and uniformity by removing distortion and correcting for variations in energy and resolution in different areas of the detector. Since then, these cameras have been improved further by implementation of automatic gain stabilization methods which maintain better field uniformity and reliability.

Single Photon Emission Computed Tomography. SPECT imaging is most frequently performed with a rotating Anger camera system. Early versions consisted of Anger cameras mounted on home-built rotating stands interfaced to regular nuclear medicine computers. Now, several SPECT systems are available commercially. These have been improved through the implementation of features such as elliptical orbit, fan beam collimation, and various volume smoothing algorithms. Clinical utility has been enhanced by the ability to reconstruct the acquired volume at any angle. This is particularly useful for cardiac imaging. Ongoing research includes implementation of cone beam or astigmatic collimators and corresponding reconstruction algorithms, to achieve better sensitivity and spatial resolution.

Dedicated SPECT Scanners. Rotating Anger camera systems are most frequently used in clinical nuclear medicine for SPECT because they are available for planar imaging also. However, attempts have been made over the years to develop dedicated SPECT scanners. Current research efforts are concentrating primarily on design and construction of SPECT scanners with cylindrical detector arrangements (using either a single NaI(Tl) crystal or a large number of small detector bars) with a rotating collimator arrangement. These units must be designed as either brain or body scanners due to the requirement that the detector be close to the surface of the patient for best spatial resolution. Dedicated SPECT scanners do not offer any significant breakthrough in spatial resolution compared to a rotating camera system. However, they increase detection sensitivity. Presently the low sensitivity of rotating single cameras and resultant lengthy acquisition times up to an hour are major drawbacks in their clinical application. Unfortunately, industrial efforts to produce well engineered rotating multiple camera or stationary dedicated SPECT systems have been modest and slow.

C. TRENDS IN COMPUTERS FOR IMAGING IN NUCLEAR MEDICINE

Advances in computer hardware development are external to nuclear medicine. Well-known features in the evolution of digital computers now being applied in medicine include progressively greater computational capacity and speed and larger memories at decreasing expense, "user-friendly" software, and networks for data sharing and communication. Embryonic efforts are being made to use "expert systems" and artificial intelligence.

In radiology and in nuclear medicine in particular, computer generation and enhancement of images has become indispensable. In some clinical nuclear medicine laboratories, computers are required to process images or extract quantitative information in up to 95 percent of all procedures. These include the following: scintigraphic ventriculography, thallium myocardial perfusion studies, gastric emptying studies, renography (split renal function, diuresis renography), pulmonary function studies (regional function, ventilation/perfusion matching), dosimetry studies of monoclonal antibodies or other new radiopharmaceuticals, reflux studies (gastroesophageal reflux, vesico-ureteral reflux), and parathyroid subtraction imaging.

Computer advances have made possible the clinical application of SPECT. Reconstructions of SPECT data relatively free of artifacts with good spatial resolution and uniformity can now be obtained clinically in a reasonable time. Clinical computer software is being developed to compensate partially for the effects of photon attenuation and scatter.

Ongoing research in SPECT involves computer software to improve SPECT image quality and quantification, including: (1) iterative (as opposed to analytical) reconstruction techniques, which have improved noise-resolution characteristics and compensation for such physical effects as attenuation and scatter, and spatially variable spread function; (2) faster quantitative analytical attenuation and scatter compensation techniques; (3) count-count-dependent Metz filtering which improves noise characteristics; (4) reconstruction algorithms for fan-beam, cone-beam, and astigmatic collimation, to take advantage of the increased sensitivity of these collimators, and (5) dynamic SPECT reconstruction techniques, which allow imaging of time-dependent activity distributions.

Commercial software is available for extracting quantitative measures from voluminous numerical data generated by scintillation cameras and other detectors. Commercial programs, nonetheless, are too time consuming, too operator dependent, and devoid of any systematic statistical base. Some programs even generate incorrect data. There is a paucity of algorithms for quantitative diagnoses based on formalized deductions or stochastic systems. Commercial providers will not generate analytic clinical software because they lack expertise in this area. Moreover, they are deterred by the Medical Device Amendments of 1976 which mandates FDA approval for any software used in clinical medicine. Hence, most software in nuclear medicine must be created by academic nuclear medicine laboratories and shared with other "users."

D. APPLICATIONS OF POSITRON EMISSION TOMOGRAPHY

The very short-lived positron-emitting radionuclides of carbon, oxygen, nitrogen and fluorine, (all naturally occurring elements), may be incorporated into a wide variety of natural substrates or neurotransmitters, and are capable of tracing processes at picomolar concentrations. After the tracer is injected intravenously, a PET scan measures arrival, uptake, and clearance of radioactivity in each part of a body organ. A computer converts these data to cross-sectional images and these, in turn, are converted to rate units such as metabolic utilization or flow by mathematical models specific for each tracer compound. With DOE support, research has made it possible to use this method in mapping measures of blood flow, blood volume, oxygen and glucose utilization, amino acid utilization, and receptor binding of neurotransmitters in living patients. These methods are now in early stages of clinical application to the study of normal aging, heart disease and cerebral dysfunctions caused by ischemic, degenerative, convulsive, and psychiatric disorders.

PET (and SPECT) has made possible important advances in understanding and diagnosing coronary artery disease. This disease is responsible for over 600,000 deaths each year in the U.S. In approximately 60 percent of these patients, a serious heart attack or myocardial infarction occurs without prior symptoms. Detection of this disease is aided by Thallium-201 imaging, but there is now evidence that PET determinations of myocardial perfusion will improve its detection and at the same time permit the physiologic severity of the stenosis to be determined. The sensitivity for diagnosing coronary artery disease with PET is greater than 95 percent and the specificity is similarly high, even in asymptomatic individuals. When myocardial perfusion measures are supplemented with determinations of myocardial glucose utilization by PET, dead scar can be distinguished from impaired, but viable, myocardium which is most likely to respond to treatment. There is great promise that PET will play an important role in the selection of those patients with ventricular dysfunctions who are most likely to be improved by revascularization procedures. This is an important public health consideration, since more than 100,000 patients have coronary artery by-pass surgery annually in the United States at a cost of more than seven billion dollars.

A major application of positron emission tomography has been in the study of cerebral perfusion and metabolism. Patients with several different cerebral disorders have already benefited from PET examination.

Epilepsy is one of the most common diseases of the nervous system. Approximately 800,000 Americans have partial complex epilepsy and, in about 20 percent of these, seizures are inadequately controlled by medication. Positron emission tomography is potentially useful in the management of these patients. In patients with epilepsy, PET imaging of cerebral glucose utilization provides information about local brain function that is quite different than that deriving from electrical measurements by electro-encephalography (EEG) or structural assessments with computed tomography (CT). The combination of PET and EEG has been very useful in presurgical evaluation for accurately determining the site and extent of seizure origin in patients with partial epilepsy, when seizures cannot be controlled by

medical treatment. The interictal PET scan effectively detects hypometabolic brain zones considered most likely to be responsible for seizures in these patients, even though these zones usually appear normal on CT scans. Such localizations can be crucial in guiding neurosurgical excision of the seizure site.

With the increasing age of our population, the numbers of persons in the United States suffering from dementia increases progressively. Over ten percent of all persons over 65 years of age are demented and half of these will eventually require institutional care. The cerebral PET scan is proving useful in the differential diagnosis of early dementia and depression in patients over the age of 55 years. Diagnostic clarification is important so that treatable causes of dementia are not overlooked. In unipolar depression, the metabolic PET scan appears normal. In multiple infarct dementia, which results from multiple small strokes, the PET scans show multiple scattered metabolic and blood flow defects in grey matter. In Alzheimer's disease, there is a characteristic decrease in glucose metabolism and blood flow in the parietal cortex which can be detected very early in the course of the disease. Different metabolic patterns have been found in some other dementing disorders. For instance, in Huntington's disease, there is a characteristic decrease in metabolism of the caudate nucleus. In Progressive Supranuclear Palsy, the frontal cortex is hypometabolic. Clinical research with PET is giving new insights which can be applied directly to the diagnosis and classification of dementias.

PET research is also uncovering the transient physiological status of the brain after stroke. Local values of cerebral blood flow, blood volume, extraction of oxygen, and utilization of oxygen and glucose have a varied and complex relationship early after stroke. This is in contrast to the more predictable relationships found in the stable chronic state. There is hope that PET will permit identification of the earliest cerebrovascular impairments so that appropriate treatment can be applied before irreversible brain damage occurs.

Assessment of tumor metabolism by means of PET makes possible better management of patients with brain tumors. Approximately 13,000 persons develop primary brain tumors each year in the U.S. Treatment is complicated by the undesired effects of radiation necrosis in brain tissue adjacent to tumor. PET helps distinguish hypometabolic necrosis from the higher metabolism of the tumor and at the same time helps estimate prognosis. PET images show higher metabolism in the more aggressively malignant tumors.

One of the most impressive accomplishments in PET research during the past ten years is a recent one, the successful characterization of cerebral neurotransmitter systems in living patients. A necessary prerequisite was the synthesis of appropriate radioligands with the required high specific activity. These were first applied successfully in man to characterize dopamine receptors and subsequently several other important postsynaptic receptor systems. Important PET studies are now underway which are expected to help unravel presently unknown features of synapse biochemistry, not only in degenerative disorders such as Parkinson's disease, but also in psychiatric illnesses such as schizophrenia and manic depressive disorders.

The pattern of success over the past ten years has been clear. With Department of Energy support, positron emission tomography has emerged as an important new research tool capable of characterizing quantitatively important physiological processes in living human subjects, for basic clinical research and, in increasing frequency, for the management of crucial medical problems.

E. PROGRESS IN DIAGNOSTIC RADIOPHARMACEUTICALS

(Positron-emitting agents, labeled monoclonal antibodies and radioactive therapeutic agents are discussed in other sections.)

For cardiology, the development of techniques for labeling autologous red blood cells with Tc-99m (accomplished largely at the Brookhaven National Laboratory with DOE support) made it possible to perform multigated gamma camera images of the heart with optimum clarity to study ventricular wall motion abnormalities and to quantitate ventricular ejection fractions by camera-computer techniques. Although this work in radiochemistry began in the early 1970's subsequent improvements extended into the 1980's. This is now one of the most common procedures in clinical nuclear medicine. The same agent is useful for detecting and localizing gastrointestinal bleeding. More recently, Tc-99m agents have been synthesized which concentrate in the normal myocardium for the detection and delineation of areas of ischemia and infarction. The most successful of these to date, methoxy isobutyl isonitrile (MIBI) is now undergoing trial in humans. Other Tc-99m myocardial agents are evolving, including lipophilic boronic acid adducts of technetium oxime complexes. These might eventually replace Tl-201, a radionuclide which has less desirable nuclear characteristics for planar and SPECT imaging. I-123 labeled fatty acids have been produced which also localize in the myocardium. A significant fraction of this work was accomplished with DOE support.

Over the years, many radiolabeled agents have been evaluated for imaging thrombi and emboli. These included fibrinogen, fibrin fragments, streptokinase, urokinase, plasmin, plasminogen and tissue plasminogen activator, but success has been far from complete. One of the most promising experimentally is fibrin fragment E, labeled with I-123. However, so far, coupling this protein with chelating agents for labeling with In-111 or Tc-99m has interfered with its binding to thrombin.

For neutro-SPECT imaging, lipophilic gamma-emitting agents have been created which diffuse readily into the brain after intravenous injection. These include labeled amines such as N-isopropyl-paraiodoamphetamine - I-123. The early images with this agent reflect regional cerebral blood flow but redistribution occurs with time. Several Tc-99m lipophilic complexes also have been synthesized for this purpose. One of these, hexamethyl propyleneamine oxime (HM-PAO) remains fixed in the brain, and reflects regional differences in cerebral blood flow. Another of this type is ethyl cysteinate dimer (ECD). These agents are undergoing limited human trials in the USA, and extensive trials outside the USA.

For gastroenterology, Tc-99m hepatobiliary agents which concentrate in the bile after excretion by the liver were under development in the early

1970's. The most successful were analogues of acetanilidoiminodiacetate (so-called HIDA compounds). The first of these was produced in 1976, but other better analogues were produced through 1981. Although In-111 chloride has been available for many years, it has been used only recently for the detection and quantitation of protein-losing gastroenteropathies, because, at low pH, it spontaneously binds to transferrin in vivo.

For nephrology and urology, ortho-iodohippuric acid (hippuran) has been labeled with I-123 for imaging the urinary tract, and for quantitation of effective renal plasma flow for individual or both kidneys. This agent is now widely used in Europe. A new agent, Tc-99m mercaptoacetyl triglycine (MAG_3), has been developed as a substitute for radiodinated hippuran, with considerable support from DOE. Like hippuran, it undergoes renal tubular excretion as well as glomerular filtration, but it produces superior images of the kidneys.

In 1976, it was found that a lipophilic chelate, In-111 oxine, irreversibly labeled blood cellular components. By the early 1980's, it was established that autologous neutrophils labeled with this agent, (or similar lipophilic chelates) after reinjection were valuable for localizing abscesses and other focal inflammatory lesions by camera imaging. These same chelates proved useful for platelet labeling for the detection of thrombi. Experimentally, In-111 labeled lymphocytes labeled with these agents have been employed in cellular immunology.

Metaiodobenzylguanidine labeled with I-131 or I-123 was synthesized in the early 1980's at the University of Michigan as an analogue of norepinephrine to localize in adrenergic vesicles of chromaffin cells. The efficacy of this agent has been established for imaging adrenal and extra-adrenal pheochromocytomas and neuroblastomas.

Recently, a device was invented in Australia for rapidly incorporating Tc-99m into carbon vapor particles with a uniform size of 5 nm. When about 50 μg quantities of these particles are inhaled in one or two breaths, images of the lungs are obtained in multiple projections which reflect ventilatory abnormalities at the alveolar level without normal deposition in the tracheobronchial tree. This agent has proven superior to radioactive noble gases such as Xe-133 or Tc-99m aerosols for detecting regional ventilatory abnormalities in the lungs. It has been useful particularly in severely ill patients with suspected acute pulmonary embolism.

F. ADVANCES IN APPLICATIONS OF "SINGLE PHOTON" GAMMA EMITTERS IN THE LAST DECADE

In the preceding Table 3, it was estimated that 7.4 million radionuclide imaging procedures were performed on inpatients and outpatients in U.S. hospitals in 1985. Non-imaging diagnostic procedures were not included in this estimate. The often-quoted figure of 10 million in vivo nuclear medicine studies in the USA per annum may be an underestimate, because of the growing number of nuclear medicine facilities in free-standing diagnostic centers and independent nuclear cardiology laboratories outside hospital institutions. Moreover, conventional scintillation camera/computer systems are being replaced with tomographic systems with greater imaging

capabilities. The number of in vitro radionuclide procedures, including radioimmunoassays and thyroid tests exceed the number of in vivo procedures several fold, according to the American College of Pathology. With the development of enzymatic immunoassay techniques, some radioimmunoassays were replaced, but others will continue, particularly for substances at very low concentrations.

Some 50 current in vivo clinical nuclear medicine procedures are listed in Table 5, arbitrarily categorized according to the frequency of their use, omitting clinical investigations. The frequency of an individual procedure varies widely from one institution to another from differences in patient population, expertise of nuclear medicine physicians and technologists, the instrumentation and radiopharmaceuticals available and other factors.

Significant changes in the clinical applications of radionuclide imaging have evolved in the last decade because of new uses of established radiopharmaceuticals, the gradual development of SPECT, and approval of a few new radiopharmaceuticals. There is now a greater emphasis on imaging for the periodic assessment of organ function and the evaluation of the effects of various drugs, rather than purely morphologic imaging. Some examples of these changing indications for imaging will be summarized.

In cardiology, ECG computed-gated radionuclide ventriculograms with Tc-99m labeled red blood cells now are performed frequently to monitor the detrimental effects of adriamycin and other chemotherapeutic agents. Conversely, this technique is useful in assessing the beneficial effects of cardiotonic drugs, e.g., beta blockers, calcium channel blockers, and thrombolytic therapy, e.g., tissue plasminogen activator (tPA), streptokinase, on myocardial function, in addition to its continued use in the diagnosis of congenital and acquired cardiac diseases. Tl-201 imaging of the myocardium during exercise and rest to detect and differentiate ischemia and infarction in coronary artery disease is rapidly expanding into the most frequent procedure in nuclear medicine. Its popularity has been augmented by the enhanced detection of SPECT imaging. This expansion may well increase when Tc-99m myocardial agents are approved. Pharmacologic intervention with intravenous dipyridamole induces a change in myocardial perfusion identical to that of physical stress. When it is approved for this application, it should provide a reasonable alternative in stress radiothallium imaging for patients unable to exercise. Other procedures include radionuclide intracardiac shunt studies and In-111 oxine labeled platelets for the detection of deep venous thrombosis, particularly in high risk patients postoperatively.

Skeletal imaging with Tc-99m diphosphonates continues to be one of the commonest studies in clinical nuclear medicine for detecting bone malignancies. However, it is being used increasingly in many non-malignant conditions, such as stress fractures and other sports injuries, occult fractures, aseptic necrosis, osteomyelitis and rhabdomyolysis. Bone imaging is another procedure improved by SPECT, particularly for resolving inconclusive findings on planar images, and more precise localization of lesions.

Table 5

Relative Frequency of Current In Vivo Clinical Nuclear Medicine Procedures

Diagnostic Imaging

Very Common	Common	Less Common	Uncommon
Skeletal	Ventillation-perfusion pulmonary	Gallium	Adrenal
Radionuclide ventriculography	Hepatosplenic	Labeled leukocyte	Gamma cisternography
Thallium myocardial	Thyroid	Cerebral	CSF shunt
Renal	Thyroid metastatic search	Gastrointestinal bleeding	Dacryocystogram
	Hepatobiliary	Gastric emptying	Eye tumor localization
	Diuretic renogram	Cystourethrogram	Gastroint. protein loss
		Scrotal	Salivary gland
		Liver-spleen red cell	Pulmonary aspiration
		Pyrophosphate cardiac	Labeled platelet
		Vascular	Marrow
			Lymph node
			Meckel's diverticulum
			Peritoneal shunt
			Occult peritoneal hernia
			Parathyroid subtraction
			Angiographic
			Intracardiac shunt
			Intrapulmonary bleeding

Non-imaging Diagnostic Tests

Thyroid uptake of radioiodine	Plasma volume	Red cell survival and splenic sequestration
	Red cell volume	Platelet survival and sequestration
	Vitamin B_{12} absorption	Ferrokinetic studies
		Quantitative red cell gastrointestinal loss
		Quantitative protein gastrointestinal loss

Radionuclide Therapy

Radioiodine for hyperthyroidism	Radioiodine for thyroid ablation
	Radioiodine for treatment of thyroid malignancy
	Radiophosphorus for treatment of polycythemia

Soft tissue infections and osteomyelitis (including infected joint prostheses) are being detected with Ga-67, In-111 oxine-labeled leukocytes or a combination of both. This has now become the principal use of Ga-67, as opposed to its earlier application in lymphomas and other malignancies. The overall sensitivity of labeled leukocytes for detecting sites of acute infection averages 85 percent. In AIDS patients, both agents have become important in demonstrating opportunistic infections, often involving multiple organs including Pneumocystis carinii pneumonia. Labeled leukocytes are proving valuable in following patients with inflammatory bowel disease such as ulcerative colitis and Crohn's disease.

Pulmonary ventilation with Xe-133 or Tc-99m aerosols and perfusion imaging with Tc-99m macroaggregated albumin continues to be the primary screening procedure for pulmonary embolism. The Tc-99m aerosols are also utilized to detect endobronchial obstruction. Camera-computer techniques with Tc-99m aerosols have successfully quantitated pulmonary epithelial permeability in smokers, patients with asthma, emphysema, adult respiratory distress syndrome and other conditions. Ga-67 imaging has become a popular procedure for evaluating the inflammatory activity of sarcoidiosis and other granulomatous diseases, particularly in the lungs and mediastinum.

In endocrinology, I-131 sodium iodide has remained important in the diagnosis and treatment of hyperthyroidism, benign thyroid tumors, and differentiated thyroid cancer. I-123 iodide is being used increasingly for camera imaging. Tl-201 has been shown to concentrate in hyperfunctioning parathyroid adenomas. By computer subtraction of a Tc-99m pertechnetate image from a Tl-201 image of the neck, about 85 percent of parathyroid adenomas can be precisely localized before scheduling their surgical removal.

Several invaluable techniques have arisen in gastroenterology. Computed tomography effectively demonstrates focal tumors in the liver, but often cannot distinguish between malignant tumor nodules or infiltration from such benign conditions as hemangioma and fatty infiltration. With Tc-99m labeled red blood cells and SPECT, hepatic hemangiomas usually can be distinguished from malignancy. By Xe-133 gas inhalation, fatty infiltration of the liver can be identified by demonstrating its delayed washout in serial camera images. Quantification of gastric emptying rates of solids and liquids with Tc-99m and In-111 radioactive tracers has become widely accepted. In recent years, hepatobiliary imaging has become popular chiefly for demonstrating acute cholecystitis due to cystic duct obstruction.

In past years, assessment of renal function by scintillation probe detectors proved unreliable. Moreover, with the advent of ultrasonography and computed tomography, radionuclide imaging became unnecessary for the detection of such focal lesions as tumors and cysts of the kidneys. However, other important applications of nuclear medicine have emerged in nephro-urology. By gamma camera-computer techniques for quantifying renal uptake, the relative glomerular filtration rate or effective renal plasma flow can now be estimated for each kidney. This is becoming established as a favored method for assessing renal function. Radionuclide cystography has become an accepted method for vesicoureteral reflux, particularly for

repeated follow-up studies in children. Another persistent problem in urology has been the inability of radiographic methods to differentiate obstructive uropathy from other causes of dilatation of the renal collecting systems. By administering a diuretic (furosemide) after Tc-99m DTPA or hippuran labeled with I-131 or I-123, quantitation of the disappearance of radioactivity from the kidneys with a gamma camera and computer has had considerable success in evaluating obstructive uropathy. This method, called diuretic renography, has become widely accepted particularly for suspected ureteropelvic junction obstruction.

During the last five years, only three new gamma emitting radiopharmaceuticals have received some form of FDA approval for human clinical use. I-131 metaiodobenzylguanidine (MIBG) (discussed in the previous section) can be used only under an approved physician's Investigational New Drug (IND) application. This limits its utility to only a few patients and restricts its therapeutic potential in malignant pheochromocytomas and neuroblastomas. I-123 labeled isopropyliodoamphetamine (IMP) and Tc-99m HMPAO recently received FDA approval to study cerebrovascular disease using SPECT imaging. Relatively high cost, I-124 contamination and cortical redistribution of the IMP are significant factors that may limit its use. However, the most serious limitation is the poor performance of existing SPECT units, including low spatial resolution and sensitivity.

G. MONOCLONAL ANTIBODY TECHNOLOGY APPLIED TO NUCLEAR MEDICINE

G.1 Radioimmunoimaging

Radioimmunoimaging is an in vivo diagnostic technique in which radiolabeled antibody binds to target antigen, so that the antigen-containing tissue can be seen on gamma camera images. The antibody then is a diagnostic pharmaceutical. It must leave the vascular space, traverse the vascular endothelium and interstitial fluid, and find its specific antigen, which usually is present only in very low concentration.

The application of radiolabeled antibodies for radioimmunodetection and radioimmunotheraphy has changed dramatically within the last decade. In the published clinical reports prior to 1980, column purified polyclonal antibodies were used as the immunoreactive molecule. The immunoreactivity was generally low, less than 50 percent, and the affinity of the immunoreactive molecules for antigens poorly defined. In general, the administered mass of antibody was less than 500 ug, labeled with 1-2 mCi of I-131. There was extensive dehalogenation of these preparations resulting in a non-reproducible distribution.

Many problems encountered with polyclonal antibodies have been solved with monoclonal antibodies. The molecules of each one theoretically are identical, maximizing immunoreactivity. Immunochemical methods have steadily improved for hybridoma culture, purification of immunoglobulins, enzymatic cleavage of fragments, conjugation with chelates and radiolabeling. Gamma emitters other than I-131 have been explored. The shorter lived radionuclides In-111, I-123 and Tc-99m have functioned best with antibody fragments. In-111 has a

half-life long enough to be useful with the intact immunoglobulin molecule.

The most successful clinical trials of monoclonal antibodies for imaging to date include anti-CEA and 19.9 for colorectal carcinomas, B72.3 for ovarian, colorectal and breast carcinomas, OC 125 for ovarian cancer, antibody against the high molecular weight antigen of malignant melanoma, 3F8 for neuroblastoma and T-101 for cutaneous T-cell lymphoma. A few others have successfully imaged non-neoplastic lesions, such as anti-cardiac myosin antibody for myocardial infarcts, myocarditis and cardiac transplant rejection, anti-fibrin and anti-platelets for thrombus detection and anti-granulocyte monoclonals for abscess detection. The sensitivity in detection of neoplasms larger than 1 to 1.5 cm. with intact monoclonal antibodies ranges from 50-70 percent, but as high as 90 percent with antibody fragments.

Many problems remain to be solved, most notably the formation of human anti-mouse immunoglobulins in the host, especially after repeated administrations. This immunogenicity may be less with antibody fragments. Determining the optimum amount (mass) of antibody or fragment to administer is difficult and varies with different antibodies. Unfortunately, biodistribution studies in immunodeficient animals with tumor xenografts or other lesions often have not predicted their biodistribution in humans. In-111 IgG usually concentrates in the liver, and labeled fragments in the kidney. Nonetheless, current work with I-123, Tc-99m, and In-111 looks highly promising for detecting a variety of antigen-tumor systems with fragments probably the immunoreactive molecules of choice because of their more rapid decrease from normal tissues surrounding the tumor. The detection of tumors with radiolabeled monoclonal antibodies is directly competitive with ultrasound, CT and MRI--modalities possessing high spatial resolution. Hence, radionuclide imaging most likely will be used for whole body surveys, or in situations where high contrast resolution can be achieved.

G.2 Radioimmunotherapy

The potential utility of radiolabeled antibodies for radioimmunotherapy is basically defined by five factors. (1) the absolute amount of the radiopharmaceutical delivered to the tumor, (2) the activity in other organs, (3) the radiosensitivity of the tumor, (4) the rad dose delivery rate, and (5) the types and energies of the radiations emitted. To date, most intravenous radioimmunotherapy has been attempted with I-131 intact antibody. Occasionally, fragments have been used. The absolute amounts of tracer in human tumors, as yet, have been extremely low, never exceeding .05% of the injected dose per gram and as low as .001% of the injected dose per gram. Under these circumstances, no more than a few microcuries would be deposited in the tumor. Furthermore, the high activity in non-tumor tissues remains a problem for virtually all of the radiolabeled immunoreactive molecules used. Their distribution varies, depending on the particular antibody, the antibody mass and whether they were intact immunoglobulin or fragment. No matter what the target organ with the highest concentration, the

radiation dose to the bone marrow remains the Achilles heel of radioimmunotherapy.

Radiosensitivity may be the major determinant in the success or failure of radioimmunotheraphy. One would expect good results in certain lymphomas because of their radiosensitivity. At the University of California at Davis, there was one positive experience with a B-cell antibody. Positive results have been reported also in T-cell lymphoma. I-131 treatment of thyroid carcinoma strongly suggests that even a relatively radioresistant tumor such as differentiated thyroid cancer can be adequately treated provided that an adequate radiation dose is delivered to it. However, in this case, the background I-131 as iodide clears so quickly that the bone marrow is spared while an active transport system serves to trap I-131 atoms presented to the tumor. Unfortunately, in comparison, the tumor uptake of radiolabeled antibody is very poor and the background clearance is slow.

There is much to recommend radionuclide labels which deliver the rad dose over a shorter period of time than with I-131 for radioimmunotherapy. Yttrium-90 labeled monoclonals have been modestly successful in Hodgkin's disease and hepatoma. Thus far, the only successful clinical trials have occurred in lymphomas.

H. OTHER THERAPEUTIC USES OF INTERNALLY-ADMINISTERED RADIONUCLIDES

Since the earliest years of nuclear medicine, P-32 phosphate has remained the treatment of choice for polycythemia vera in preference to any chemotherapy agent. I-131 sodium iodide likewise remains the treatment of choice for hyperthyroidism and also for differentiated thyroid carcinoma with local spread or distant metastases after thyroidectomy. Phosphorus-32 chromic phosphate colloid injected intraperitoneally or intrapleurally for the suppression of malignant effusions is now used infrequently. After a long quiescent period, other therapeutic uses of radionuclides have emerged in the last decade.

I-131 metaiodobenzylguanidine was developed at the University of Michigan as an analog of guanethidine. Because of structural similarities to norepinephrine, this agent is taken up in catecholamine storage granules in sympathetic nerve endings and adrenal medulla (previously mentioned in Radiopharmaceutical section). It has proven highly effective not only for detecting pheochromocytomas by imaging, but also in the treatment of malignant pheochromocytomas. In some series, malignant tumors represent only ten percent of all pheochromocytomas. At the University of Michigan, however, after a prolonged follow-up of a large series of patients as many as 46 percent of pheochromocytomas develop metastases, particularly in the liver, skeleton, lymph nodes and lungs. Some of these malignant tumors are unresectable when first diagnosed, yet may be effectively treated with I-131 MIBG. CAT and SPECT imaging are useful for quantitation of tumor size, location and degree of uptake. This agent delivers a tumor dose averaging 2000 rads/100 mCi administered, and with repeated doses as many as 20,000 rads have been delivered to these tumors. Some neuroblastomas also concentrate this agent. An objective therapeutic response is obtained in about 30 percent of children with this malignancy, after 200 mCi in each of

three doses. A small percentage of other apudomas also concentrate this agent, but it has not been used therapeutically for these tumors.

From one to three percent of the U.S. population suffer from rheumatoid arthritis. Persistent synovitis frequently involves the knees, progressing to articular cartilage destruction and crippling. For over 25 years, patients in Europe with painful synovitis of the knees refractory to medical treatment have been relieved by intraarticular injections of colloids containing radionuclides such as Y-90, Au-198, Er-169, Re-186, and P-32. However, the half-lives of most of these radionuclides are too long, and leakage of radioactivity into regional lymph nodes, liver and plasma is a major problem. More recently, in clinical trials in the U.S., Dy-165 (half-life only 2.3 hours) in the form of ferric hydroxide macroaggregates has proven highly effective and the extraarticular leakage is negligible. This new procedure is obviously less traumatic than the alternative-surgical synovectomy.

In the past, the combination of P-32 phosphate and testosterone proved moderately effective in the palliative treatment of bone pain due to metastatic cancer of the skeleton, particularly from breast and prostate carcinomas, when conventional therapy has failed to control the pain. The P-32 phosphate, localizing in the bone marrow, often caused marked marrow depression. This hematological complication has been overcome in recent extensive clinical trials of Sr-89, a beta emitter with a half-life of 50.5 days. After one to four doses of 2.8 mCi, about ten percent of patients become pain free, 68 percent are improved, and 22 percent have no response. In the majority of these patients, the narcotic medication can be reduced. The efficacy of this approach is attributed to the greater uptake of strontium in healing bone compared to normal bone by a factor of five and the biological halftime in these lesions is longer than in normal bone. Because of the long, physical half-life of this radionuclide, radioactive waste handling and storage become a significant problem. Moreover, many patients die of their malignancy within three months with residual radioactivity in the skeleton. To overcome these problems, two other radionuclides with a shorter half-life have been developed at the University of Missouri Research Reactor--Re-186, with a half-life of 90 hours and Sm-153 with a half-life of 46 hours. To obtain localization in the skeleton, they are used as phosphonate complexes. Re-186 HEDP localizes in the skeleton similarly to the widely used bone imaging agent, Tc-99m MDP. Sm-153 EDTMP complex reaches an even higher concentration in normal bone than Tc-99m MDP and the lesion-to-normal-bone ratios of these two agents are similar. This latter agent has produced a good therapeutic response in spontaneous bone tumors in dogs, and clinical trials are now under way. Both of these therapeutic agents have gamma emissions suitable for localization of the bone lesions by gamma camera imaging.

External radiation therapy of hepatic malignancies is only palliative because the limited tolerance of this organ is only 1500 rads. In cooperation with industry, the University of Missouri has developed inert glass microspheres 20 to 30 um in diameter incorporating either 14-day P-32 or 64-hour Y-90. Leaching of radioactivity from these products is negligible compared with the older plastic microspheres. They provide the potential for high dose irradiation of hepatic metastases, malignant

melanomas or hepatomas by selective injection through a catheter in the hepatic artery or its branches. The rationale for this approach arises from the fact that 80 percent of the blood flow to normal liver is via the portal vein, whereas hepatic tumors are supplied almost exclusively by the hepatic arteries. In dogs, doses as high as 18,000 rads are well tolerated. Limited clinical trials for hepatic malignancies are now underway in Canada, using 50 mCi doses of Y-90 microspheres.

IMPORTANT AVENUES FOR FUTURE RESEARCH IN NUCLEAR MEDICINE

PRODUCTION AND AVAILABILITY OF STABLE AND RADIOACTIVE NUCLIDES

Production and availability of many of the radionuclides discussed previously have been a concern of the nuclear medicine community. DOE should focus on this need, since its facilities are the only practical source of radionuclides for research. During the last decade, DOE-supported isotope production facilities have operated mainly at BNL, LANL and ORNL. The emphasis has been on the production of radionuclides (at BNL and LANL) primarily to support on-site research programs. These machines (BLIP at BNL and LAMPF at LANL) run only intermittently and in a parasitic mode of operation for radioisotope production. DOE support of a dedicated isotope production facility should be seriously considered either by expanding the capabilities of the existing machines or through the installation of a new high-energy cyclotron or linac devoted to this purpose. The operating costs will be difficult to recover completely through sales and distribution of these radionuclides.

Even though it is expected that Tc-99m will remain the most dominant radionuclide during the coming decade, other radionuclides will be needed for specific applications. Improved availability of I-123 will be important. The network for production and distribution of this radionuclide in Europe has been much more successful than in the U.S. The TRIUMF (Tri-University Meson Facility in Canada, administered by the Atomic Energy of Canada, Ltd.) has begun to produce high-purity I-123 (using enriched Xe-124 target). For a number of applications, I-123 is the ideal radionuclide and if made available routinely at low cost, it would be adopted for some very important radiopharmaceuticals. To date, clinical investigators in the U.S. have been frustrated, and reluctant to exploit the clinical use of I-123 since it is not available routinely, and the cost remains quite high. A reliable source for this nuclide, in the U.S., must be developed.

Research on radiolabeled monoclonal antibodies is predicted to grow at a rapid pace. Concordant with these developments, there will be a need for better radionculides for imaging and therapy of the brain, heart and malignant tumors. The promising ones include Ru-97, Pb-203, Br-75, Cu-61, Cu-62, Cu-64, Co-55, Zr-89, and As-72, for imaging planar, SPECT or PET techniques. Demand for nuclides such as In-111, Tc-99m, Ga-67, Ga-68, I-123, F-18, etc., will continue also. There is a special need for high specific activity In-111 free of trace metal contaminants for labeling monoclonal antibodies and other proteins which is not available commercially. Tc-99m, if available, would prove invaluable in experimental comparisons of similar Tc-99m radiopharmaceuticals in animals. For radioimmunotherapy. I-131 still will be employed, but many others already under investigation will continue to be developed. Examples are: Sc-47, Cu-67, As-77, Y-90, Rh-105, Pd-109, Sm-153, Re-186, Re-188, Au-199, and the alpha emitters At-211 and Bi-212. While reactor production of some of these is possible, most will require high energy reactions for economical production of large quantities with high-specific activity.

A number of short-lived (daughter) radionuclide generator systems have been identified recently and will require continued development. Some are already undergoing investigation and evaluation. The important ones include: Sr-82/Rb-82; Rb-81/Kr-81m; Hg-195/Au-195m; Os-191/Ir-191m; W-178/Ta-178; and Cd-109/Ag-109m. The chemistry of separation for a number of these requires further development before any clinical application. Other radionuclide generator systems, e.g., Sr-90/Y-90, Se-72/As-72, and Pb-212/Bi-212 could be useful for monoclonal antibody immunotherapy but will need to be developed and refined.

Production and development of a number of stable isotopes is needed, including Ca-48, O-18, Xe-124, Xe-126, S-33, and various Si isotopes.

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FUTURE DEVELOPMENT OF DETECTORS AND IMAGING SYSTEMS

CYCLOTRONS AND PET IMAGING DEVICES

Modern cyclotrons for PET radionuclides perform well, but are bulky, heavy, and occupy a large amount of space. Including the radiation shielding, they represent a large fraction of the cost of a PET facility. Hence, a less bulky, less expensive device for the production of the PET radionuclides is needed. This can be accomplished by improvement in cyclotron design or the creation of new and different accelerators.

An accelerator capable of producing only Oxygen-15 would prove useful because of its versatility in different PET studies. Such a limited device could be built less expensively, could be simple to operate, small, and highly reliable.

Further development of radionuclide positron emitters with half-lives of at least a few hours would relieve the dependency on immediate cyclotron production for certain applications.

Although commercial PET imaging devices have already reached a great degree of maturity in performance, existing systems could be improved further in spatial and temporal resolution and sensitivity. With existing technology, however, improved resolution could be achieved only by increased costs or a loss in sensitivity. Rational research projects in new, less costly technology should be encouraged. In addition, it would be highly desirable to develop a less expensive device probably by sacrificing some resolution to make this technology accessible to a larger number of hospitals that may be incapable of financing expensive present systems. The cost of such units might be reduced to 5-6 hundred thousand dollars from the 1-2 million dollars for present commercial PET systems.

The search should be continued for better radiation detectors for PET than the existing scintillation detectors. Because of neuroanatomical considerations, efforts to advance the instrumentation to the physical limits of PET are encouraged.

PLANAR AND SPECT INSTRUMENTATION

Planar Scintillation Cameras. Development of alternative detectors to the basic Anger scintillation camera (consisting basically of a slab of NaI(Tl) scintillator coupled to a large number of photomultipliers) has come to almost a complete standstill. This is not likely to change in the near future because the detection efficiency of NaI(Tl) is essentially 100 percent for low energy emitters such as Tc-99m (140keV), and the spatial resolution is largely limited by the collimator which is essential for all single photon radiopharmaceuticals. One of the major remaining shortcomings of the Anger camera is its relatively poor energy resolution of approximately 50 percent scattered radiation in a typical camera image. Unfortunately no practical detector with better energy resolution is on the horizon. However, some modest improvement in image quality can be achieved through the implementation of more sophisticated methods dealing with scattered radiation. These are likely to make better use of all radiation impinging on the detector, instead of merely using a single energy window to make an accept/rejection decision for each detected gamma ray.

Single Photon Emission Computed Tomography. SPECT imaging will probably be the most active research area in nuclear medicine instrumentation in the next ten years. Rotating Anger cameras can be improved by further development of cone beam and astigmatic collimators not only for the brain but also for the heart. These collimators will require new reconstruction algorithms dealing with incomplete data (rotations less than 360 degrees). This applies particularly to cardiac imaging, where some radioactivity will be within the field of view of the detectors at some angles but not at others.

The new Tc-99m agents for both the brain and heart will increase the demand for dedicated SPECT Scanners. This area of research needs to be strengthened and expanded. At present, less than five institutions have a strong ongoing research effort in pursuing this approach, some of this work is unduly delayed by a lack of adequate funding. The most likely configuration of a successful dedicated SPECT scanner consists of a stationary arrangement of scintillation crystals and a rotating collimator assembly. For both rotating Anger cameras and dedicated SPECT scanners, more work is needed in attenuation correction, scatter reduction and correction, collimator design, and image quantitation.

IMPORTANT FUTURE RESEARCH IN NUCLEAR MEDICINE REQUIRING COMPUTER SOFTWARE DEVELOPMENT

1. Improvements in SPECT image quality and quantitation

For better images, simultaneous consistent compensation for photon attenuation and scatter is theoretically possible with some iterative techniques. This will require considerable computer speed and power and substantial further development. Analytical techniques for improved quantitation likewise involve mostly software development especially when fast processing is necessary. Existing algorithms for cone beam reconstruction are somewhat inaccurate and may produce image artifacts which should be eliminated by further research.

2. Dosimetry in monoclonal antibody studies:

If radioimmunotherapy is to become a useful clinical tool, efficacious methods are required to predict the dosimetry on individual patients based on whole body scintigraphy, with standard area of interest derivation, and an immediate analysis for extracting dosimetric measures from serial images.

This would include the analysis of count rate versus time curves with irregular sampling intervals, the estimation of three-dimensional distributions from two-dimensional mappings, and quantitative concentration estimates from SPECT data. Similar methodology would be invaluable for determining the biodistribution of other new radiopharmaceuticals.

3. Quantitative diagnostic studies:

These would require image acquisition and numerical value extraction on individual patients, and ready access to databases, so that the degree of deviations from the normal average distribution of various quantitative parameters could be generated. The probability and extent of the disease could then be deduced and modified according to the patient's clinical status and test circumstances.

4. Studies of image parameter comparisons:

In many imaging studies various parameters are used to measure identical underlying physiological phenomena, but there is a lack of correlation between these parameters. As a result, the most efficacious methods of analysis are often unknown. For example, the EKG-gated images of the ventricles of the heart "functional" images of ventricular wall motion, including phase analysis, regional ejection fractions, and cine mode displays may be generated. It remains to be determined to what extent each of these yields independently useful information, to avoid subjective bias in the interpretation, and to eliminate unnecessary exhaustive analysis.

5. Analysis of three-dimensional data:

Computer-driven devices (such as Pixar) are available for the generation and display of three dimensional images obtained by CT or MRI. SPECT images likewise contain coherently three-dimensional data and could be similarly displayed. To provide anatomical reference information, a second tracer with different localizing properties may be necessary. Extraction of quantitative data from anatomical volumes of tissue (rather than areas) remains to be achieved. Moreover, the value of extracting non-orthogonal slices from three-dimensional data remains to be explored.

FUTURE RESEARCH IN THE APPLICATION OF EMISSION TOMOGRAPHIC IMAGING

In addition to the aforementioned need to develop more sophisticated hardware, software and experimental methods that will result in reduced complexity, increased practicality and better quantification are needed in PET/SPECT research. Support is required for the continued introduction of new positron emitter labeled tracers. It is important that validation efforts be supported, including measurement and modeling of kinetics and biodistribution in animals and humans. More effective high-speed parameter estimation for tracer kinetic modeling will be required. Special attention should be given to supporting new extensions of the PET/SPECT methods capable of testing important medical hypotheses.

There is hope that PET will provide important new clues concerning the nature of major mental diseases such as schizophrenia and manic depression in which neuropathological abnormalities have not been identified at autopsy. There is every reason to expect that many of the exciting results obtained by PET techniques eventually will be able to become widely applied through improved SPECT technology. Emission tomographic imaging is particularly appropriate since it can be applied to living patients for measurement of process rates which are inaccessible in autopsy material.

FUTURE DIRECTIONS IN THE DEVELOPMENT OF DIAGNOSTIC RADIOPHARMACEUTICALS

Today, agents containing short-lived gamma-emitting radionuclides are available for outlining the morphology of most of the major body organs by gamma camera imaging. What are now needed are agents with higher cellular and tissue specificity including receptor-binding agents such as steroids for membrane proteins of specific cell types, radiolabeled antagonists for specific neuroreceptors, and substrates which follow specific metabolic pathways. As examples, I-123 3-quinuclidinyl-4-iodobenzilate (4-IQNB) recently has been prepared as a muscarinic acetylcholine receptor tracer and I-123 benzamine (IBZM) as a D-2 dopamine receptor antagonist. Compounds developed for PET imaging could well serve also as models for the design of analogues suitable for labeling with "single photon" radionuclides.

Because thrombosis and atherosclerosis affect the function of so many organs especially in the aging population, and constitute the major cause of death, concerted efforts should be made to devise and create agents which could localize well in thrombi and the different types of atheromatous lesions. Then, gamma camera imaging could be used to follow the course of this disease, and substitute at least partially for contrast angiography.

Generators for ultra-short lived gamma-emitting radionuclides should be developed more completely and with greater safety. Relatively large doses of radioactivity then could be administered for first transmit or "perfusion" images of many organs and generate statistically superior time-activity curves. One example is 30 second Au-195m. It has a gamma emission of .262 Mev and is available from a generator containing the parent radionuclide Hg-195m. However, such generators need to be modified to reduce the breakthrough of the parent radionculide in the eluate.

Better gamma-emitting radioactive agents are needed for labeling the leukocyte subpopulations, especially for lymphocytes because the current agents concentrate in the cell nucleus and induce autoradiolysis in these radiosensitive cells. If agents could be created to localize only on the cell membrane, or at least remain confined to the cytoplasm, in vivo cell trafficking could be better studied both under normal conditions and in immunopathologic states. In adoptive immunotherapy with various types of lymphocytes expanded in Il-2 cultures, examining their migration in vivo with superior cell labels will become important in the assessment of their efficacy in the treatment of neoplasms.

Better bifunctional chelates for Tc-99m and other radiometals are needed for conjugation of monoclonal antibodies and other proteins. Many human proteins with highly specific function are now becoming available by recombinant DNA technology. For metabolic studies of longer duration, intermediate half-life radionuclides such as In-111, Pb-203 and Ru-97 will be more appropriate. A source of these radionuclide free of trace metal impurities, is not readily available, but badly needed by the nuclear medicine research community for several applications, including monoclonal antibodies. Several single photon gamma emitters are suitable for long-term metabolic studies of large molecules such as proteins and polypeptides, because after the conjugation and labeling steps, the metabolic pathway

usually remains the same as the native molecule at least for several days. In contrast, most PET experiments follow short-term metabolic events. In the future, it is anticipated that there will be a greater emphasis on studying abnormal metabolic events in various disease states such as myocardial ischemia, atherosclerosis and neoplasms rather than merely organ imaging.

IMPORTANT FUTURE APPLICATIONS OF "SINGLE PHOTON" GAMMA EMITTERS

The Subcommittee believes that the future goal of the DOE in the development of "single photon" gamma emitters for diagnosis should continue to emphasize radionuclide production, new radiopharmaceuticals, improvement in instrumentation and preclinical trials. Most of the clinical investigations of these new developments will probably be supported by other means. A few examples of clinical trials to establish the efficacy of new procedures are outlined below.

In cardiology, as in other fields, the radionuclide methods will be compared with other non-invasive modalities including Doppler and two-dimensional echocardiography and gated MRI for assessment of ventricular function. Radionuclides will certainly be used to monitor the toxicity and efficacy of drugs, such as thrombolytic therapy in acute myocardial infarction. They will be important in studies of silent myocardial infarcts, and so-called syndrome X (myocardial ischemia with normal coronary arteriograms). More comparisons will be needed between Tl-201 and the newer Tc-99m myocardial agents for SPECT imaging of the heart in different diseases.

In oncology, agents other than monoclonal antibodies will undoubtedly be tried, similar to the recent demonstration of malignant melanomas with I-123 iodoamphetamines, and apudomas with I-131 or I-123 metaiodobenzylguanidine.

There has been a rebirth in brain imaging after the development of lipophilic gamma-emitting agents and SPECT. This will continue to grow, particularly as the new Tc-99m brain agents are approved by the FDA, besides the initial agent I-123 iodoamphetamine. These SPECT images have already yielded functional information on relative regional differences in cerebral blood flow - information not obtained by the anatomical modalities, CT and MRI. Studies of immediate interest include: (1) differentiating multi-infarct dementia from Alzheimer's disease, (2) defining the extent of avascular areas in acute stroke, (3) focal reductions in cerebral blood flow in transient ischemic attacks and migraine, (4) detecting ischemia due to vasospasm induced by subarachnoid hemorrhage, (5) evaluation of changes before and after intracranial neurosurgery, (6) identifying focal areas of hyperperfusion or hypoperfusion associated with epilepsy, (7) evaluation of patients with neuropsychological disorders after open heart surgery, (8) assessing early and late effects of head trauma, and (9) psychoses such as schizophrenia.

FUTURE RESEARCH IN ANTIBODY TECHNOLOGY APPLIED TO NUCLEAR MEDICINE

Most of the future research in radiolabeled monoclonal antibodies can be divided into three major topics (1) quantitative biokinetics, (2) identifying and producing radionuclides optimal for imaging or therapy, and (3) methods of conjugating chelates to antibodies without altering the kinetics or distribution in normal or malignant tissues.

1. Quantitative Biokinetics

Successful radioimmunotherapy of neoplasms will require careful selection of the dose of radioactivity for each individual patient, based on a diagnostic dose no more than a week earlier. This will determine whether or not significant tumor uptake occurs and what the distribution is in the body organs. What is sorely needed is a method for acquiring quantitative data at measured depths, i.e., percent injected dose/gram in the tumor and critical organs. This might be achieved by SPECT or, if this is impossible, by PET.

2. Optimal radionuclides for detection and therapy

The selection of the best radionculide will vary with each antibody or fragment, because they are affected differently by the chemical manipulations in the labeling process. Besides I-131, I-123, Tc-99m and In-111, other radionuclides are suitable for imaging. These include Ga-67, Pb-203, Ru-97 but their usefulness in immunoscintigraphy has not been explored. The utility of Pb-203 and Ru-97 will depend on their production and availability, and appropriate labeling chemistry would have to be developed.

Positron emitters also should be considered for antibody labeling. With certain antibodies and fragments whose uptake kinetics are reasonably fast, positron labeling will offer the advantages of better resolution and quantification of data. Imaging with as little as 20 percent higher uptake in target tissue compared to the background areas is feasible with PET. In addition, more precise measurement of radionuclide distribution volumes becomes possible. Examples of positron emitters that should be investigated include F-18, Br-75, Cu-64, Ga-68, Co-55, Zr-89, and As-72. Some have half-lives of over 12 hours, so that the labeling chemistry and imaging times can be reasonably long and comparable to those of single photon emitters. A particularly interesting combination is Cu-64 and Cu-67, the former for dosimetry studies using PET and the latter for radioimmunotherapy. With this combination, the problems of different in vivo behavior of the imaging nuclide compared to the therapeutic nuclide can be eliminated.

Radioimmunotherapy

In the selection of radionuclides for radioimmunotherapy, the important physical variables to consider include the half-life, the type, energy and branching ratio of particulate radiation, the gamma-ray energies and abundances. The radionuclide must be free of carrier or contaminating elements. The physical half-life should match the antibody in vivo pharmacokinetics.

One to three days is usually required to reach maximum target-to-nontarget uptake ratios. The non-uniform distribution of antigens in tumors reduces the attractiveness of short-ranged Auger and alpha-emitting radionuclides for radioimmunotherapy. The longer range beta particles of medium to high energy can produce uniform tumor irradiation.

Radionuclides emitting beta particles and gamma rays suitable for imaging allow diagnostic low-dose experiments to determine biodistribution prior to administering the therapeutic dose of the same preparation. The most attractive therapeutic candidates are listed in the section on radionuclide production. Of these, Cu-67, Sm-153, Re-188, and Au-199 are especially promising.

The high energy beta emitters have better target/non-target dose ratios, but if gamma emissions are weak or absent preliminary biodistribution studies must be performed with other radionuclides. Labeled antibody distribution is often radionuclide dependent. The candidates with good physical properties include As-77, Y-90, Pd-109, Pr-142, Pm-149, Gd-159, Ho-166, Re-186 and Ir-194. Of these, Y-90, Pd-109, and Re-186 are being investigated currently.

3. Improved methods of conjugation

The currently popular methods of conjugating monoclonal antibodies for In-111 labeling with the cyclic dianhydride or mixed anhydride of DTPA are not ideal. The uptake in the liver is high, and the immunospecificity of some monoclonal antibodies is lowered. "Site-specific" labeling of chemically modified carbohydrate moieties in the Fc region with DTPA analogues generally keeps the chelation site away from the antigen-binding sites of the Fab regions, but this method cannot be applied to antibody fragments.

Other chelates should be explored to maximize the in vivo stability and immunospecificity of the labeled monoclonals. Other radionuclides often require different chelates and coupling methods. For instance, chelates for trivalent In-111 usually do not chelate Tc-99m or Cu-67 well. For Tc-99m, analogues of tetradentate ligands such as DADS (diaminodisulfhydryl compounds), cyclam and oximes already have shown some success. Recently, labeling analogues of biotin and streptavidin have been explored for coupling and in vivo localization of monoclonal antibodies, to take advantage of the high stability of the biotin-avidin complex.

Thus, a systematic investigation of chelation technology will be indispensible for improvement in the localization of radiolabeled monoclonal antibodies. Furthermore, it is probable that the conjugation or chelation techniques may be applied to non-radioactive chemotherapy compounds and modifiers useful for treating various malignancies.

4. Non-systemic therapeutic applications of labeled monoclonal antibodies

Future therapeutic trials should include routes of administration other than intravenous injections, such as intracavitary or intralymphatic administrations.

OTHER THERAPEUTIC USES OF INTERNALLY ADMINISTERED RADIONUCLIDES

The treatment of persistent synovitis by the intra-articular injections of Dy-165 macroaggregates or similar materials should be extended to other joints such as the small joints of the hands, wrists, elbows, shoulders and ankles in rheumatoid arthritis. This approach should be applied also to other joint diseases such as hemophiliac arthropathy, pigmented vilonodular synovitis and seronegative arthritides.

In the future, there should be greater emphasis on trials of short-lived radionuclides for therapy, including short-lived alpha emitters. Short-lived radionuclides would allow the study of dose fractionation morphologically and biochemically. The effect of biological response modifiers in either enhancing or suppressing radiation effects also could be examined for fractionated doses.

High priorities should be given to projects developing radiopharmaceuticals which enter specific metabolic pathways, similar to the discovery of I-131 MIBG.

Efforts to improve the methods of protein labeling should be encouraged. If successful, these would benefit not only research with monoclonal antibodies but other proteins, lipoproteins and glycoproteins of physiological importance as well.

There should be a greater emphasis in defining the distribution of therapeutic radionuclides at a cellular and intracellular level for better defined microdosimetry estimates. This would enable better matching between the energy of the emissions of specific radionuclides to the path lengths required to eradicate the neoplastic cells.

SUBCOMMITTEE'S RESPONSE TO THE SPECIFIC QUESTIONS IN THE CHARGE

Question 1. Is there an adequate balance between the different components of the Nuclear Medicine Program, specifically within and between the non-clinical and the clinical activities. If not, what are your recommendations to improve this situation?

Response

It has been an established practice that the DOE support predominantly non-clinical, i.e., basic science and pre-clinical, research. In this regard, it is the opinion of the Subcommittee that this priority continue. The present balance between non-clinical and clinical activities seems appropriate and the Staff is encouraged to continue to resist increasing pressures to expand support of clinical studies. Clinical studies should continue to be supported by other agencies, such as the NIH and the American Cancer Society. With regard to the budget, it is estimated that, in FY 1988 out of the budget of 34.2 million dollars for research in Medical Applications, about $15 million will be allocated to projects outside the field of nuclear medicine. It is recommended that the budget for nuclear medicine be separated from these other areas of research within the category of Medical Applications. Within the budget for nuclear medicine per se, in the opinion of the Subcommittee, the DOE Nuclear Medicine Program is out of balance in certain respects. The support for radionuclide production, radiopharmaceutical development, imaging devices and radionuclide therapy categories (other than positron emitters and labeled monoclonal antibodies) is very modest. Support for this portion of the nuclear medicine research program must be maintained over the long term and should be expanded over the short term (see Recommendations). It is recommended also that peer reviews of other non-nuclear medicine projects in Medical Applications be conducted separately, perhaps by ad hoc panels with expertise in specific areas of research, analogous to ad hoc Study Sections of the NIH.

Question 2. Is the on-site research effort adequately exploiting the physical and interdisciplinary resources available in DOE facilities? Are they sufficiently committed to forefront research objectives? Is the program's productivity commensurate with the resources available?

Response

The Subcommittee did not review individual research programs because during its tenure, an in-depth program analysis was conducted by separate committees reporting directly to the Office of Energy Research. As a result of previous individual site visits and program reviews of some Subcommittee Members to DOE facilities, the opinion is that the intramural scientists are seriously committed to forefront research exploiting the available resources. Conversely, these Members believe that some research projects of relatively low merit have been supported too long. The Subcommittee recommends that the policy to peer review all research projects, both intramural and extramural, at least every five years be continued.

Question 3. Is there appropriate program distinction between DOE-sponsored efforts and work-for-others conducted in DOE facilities; between DOE efforts and that sponsored elsewhere by other Federal agencies or the private sector?

Response

The Subcommittee believes it appropriate that investigations within DOE laboratories sometimes are supported partially by other agencies or involve collaboration with other institutions. Because of a relatively static DOE budget in some areas of nuclear medicine from year to year, scientists in DOE facilities out of necessity will seek out other agencies to support research they perceive as interesting, meritorious, and complementary to their DOE mission.

The Subcommittee believes that there is sufficient distinction between DOE-sponsored research from that of other Federal and private agencies. DOE research remains oriented primarily to the development and refinement of new instrumentation and new methods, whereas NIH-supported research is fundamentally disease-oriented. Inevitably, some areas of overlapping interest occur between agencies, particularly in the transition from development to evaluation of new devices and new radiopharmaceuticals. Careful monitoring of research budgets by DOE contract management may be necessary to avoid duplication of support with other agencies for the same research.

Question 4. Are there any research areas and opportunities that the Program should address, or should expand on? Enough to warrant the development of a major new initiative?

Response

Because progress of nuclear medicine research, basic and applied, depend mightily on the reliable availability of a full spectrum of radionuclides, a source to provide this essential ingredient is imperative. None of the nuclear medicine research programs, clinical trials, new techniques, new instrument development, new radiotracers (radiopharmaceutical development) can proceed without a continuously reliable source of radionuclides. Therefore, the Subcommittee strongly urges DOE to develop a facility capable of delivering a continuous supply of established and novel radionuclides for research. This would constitute a major, new initiative, because this "continuous supply" has never been achieved in the USA, although this goal has been reached in other well developed countries. This goal is one of the most important recommendations of the Subcommittee (discussed previously in the Summary of Recommendations). If this goal were fulfilled, it would make available many new opportunities for research in diagnostic and therapeutic applications of radionuclides in nuclear medicine. Under the present conditions, scientists are discouraged from embarking on research utilizing promising novel radionuclides available only intermittently and haphazardly.

The radionuclides for research should be made available to all peerreviewed, approved and funded research projects, and not restricted to those supported by DOE.

Question 5. Is there an adequate balance between the funding of research activities and expenditures for capital equipment and construction? If not, what would the Committee consider a proper mix under different budget scenarios?

Response

The Subcommittee understands that only the equivalent of 4 percent of the nuclear medicine research budget was allocated in FY 1987 to capital equipment and construction. We believe this is an alarmingly low proportion. Moreover, it is common knowledge that the facilities and equipment of the DOE nuclear medicine program are aging, and that some facilities have been closed because of fiscal restraints. The Subcommittee recommends that if a zero gain budget for nuclear medicine continues, every effort should be made to maintain meritorious DOE research activities. In the event that its budget should increase, an equivalent of 10 percent of its nuclear medicine research budget would be a minimal proportion required to effect a significant improvement in the DOE facilities. In comparison, an academic department of radiology must appropriate a minimum of about 15 percent of its budget to avoid progressive obsolescence of its equipment, aside from the acquisition of new imaging modalities.

Question 6. Are the present facilities and technologies for the development and production of new radioisotopes and radiopharmaceuticals adequate? How could these resources be improved?

Response

The Subcommittee firmly believes that the present facilities for the development and production of new radioisotopes and radiopharmaceuticals are not adequate and, therefore, is proposing a major new initiative described in answer 4 above and in the Summary of Recommendations. The DOE plays a unique role in the production of stable and radioactive isotopes--without adequate support for this activity, research in most other areas of research in nuclear medicine cannot progress.

Question 7. Is the input from the clinical and radiopharmaceutical sides of the nuclear medical community into the program adequate? If not, what can be done to improve this communication?

Response

The Subcommittee perceives that communications between the nuclear medicine community and the DOE Nuclear Medicine Program could be improved. Currently, personnel in the clinical facilities at the community level communicate with commercial radiopharmaceutical companies and are largely

unaware of the vital importance of DOE in advancing the field. At the academic level, physicians and other scientists are not sufficiently informed of the recent research accomplishments of DOE facilities, the targets for research that DOE believes important to support, or the mechanisms for seeking such support.

The Subcommittee suggests that communications from DOE could be improved by issuing two publications--(1) a brief annual report of progress in DOE activities in nuclear medicine addressing all licensees in nuclear medicine, and (2) a more frequent bulletin for nuclear medicine research facilities outlining current DOE activities in nuclear medicine, identifying those activities DOE is interested in supporting, soliciting ideas for future research, and describing the procedure for applying for DOE support. These bulletins would resemble the periodic notices now issued by NIH. The annual publication containing the abstracts of all currently funded DOE research is excellent and should be continued. The Subcommittee understands that it is not circulated to all nuclear medicine research and/or academic facilities. The DOE supported annual symposium "Frontiers of Nuclear Medicine Series" also is commendable, but not well publicized. In summary, various means should be considered to give DOE research efforts and achievements more visibility to the nuclear medicine community, without increasing the number of progress reports required from the scientists it supports.

Question 8. Are the mechanisms for technology transfer of research results to application in community timely and effective? Are there undue delays between the first proof of feasibility of new applications, through proof of efficacy and safety, to clinical routine applications? What does the Committee suggest to improve any shortcomings in these respects?

Response

The Subcommittee contends that there are at least two major factors hindering the practice of nuclear medicine in the U.S., the lack of continuous production of new radionuclides and the undue delays in the technology transfer of research accomplishments to clinical practice at both academic and community levels. The first factor has been addressed (vide supra).

The slow technology transfer had emerged in the U.S. because of excessive regulation by various agencies including the FDA, NRC, agencies of the Agreement States and others, particularly for the introduction of new devices, new computer software, and new drugs including radiopharmaceuticals. The formal organizations in nuclear medicine have repeatedly appealed especially to the FDA to simplify and speed up its regulatory processes, with no tangible results to date. The Subcommittee could identify in detail the reasons for the undue delay in technology transfer, but the Subcommittee recognizes that problems in the regulation of the medical uses of radioisotopes in patients and redress of this situation are beyond the purview of DOE.

SUMMARY OF IMPORTANT AVENUES OF FUTURE RESEARCH

1. Radionuclide production

   (a) continuous supply of I-123 with high radiochemical purity

   (b) intermediate half-life gamma emitters such as Ru-97 and PB-203 with high radiochemical purity for radiochemical, radiopharmaceutical and animal research

   (c) radionculides optimal for therapy, such as Re-186 and Sm-153

   (d) continuous supply and sufficient quantities of established radionuclides still needed for investigations, e.g., Ge-68, Sr-82, Xe-127

   (e) further improvement in the development of generator systems for ultra short-lived daughter radionuclides

2. Imaging development

   (a) positron-emitters

      (i) continued support of existing cyclotron and PET facilities for research and clinical feasibility studies

      (ii) creation of better annihilation photon detectors

      (iii) development of a small, less expensive cyclotron

      (iv) more efficient automated systems for radiopharmaceuticals incorporating the short-lived positron-emitters

However, the proliferation of cyclotron-PET facilities predominantly for clinical diagnosis should not be supported by DOE.

   (b) planar and SPECT imaging systems

      (i) scintillation cameras are relatively mature instruments and need no future support from DOE, because the potential for significant gains in performance is relatively small

      (ii) DOE should place a high priority on supporting research in the design and construction of better instruments for SPECT imaging. In addition to fundamental improvements in detector arrays, better collimator design (with necessary software changes) and better reconstruction algorithms are needed.

3. Computers in nuclear medicine

   (a) computers sufficient for nuclear medicine applications are available commercially; hence, OHER should not support hardware development

   (b) efforts in software development for research in nuclear medicine should be supported in the following areas:

      (i) modeling of plasma kinetics and biodistribution of labeled monoclonal antibodies for radiation dose estimates prior to radioimmunotherapy

      (ii) quantitation of physiological and abnormal function of specific body organs from serial camera images

      (iii) comparison of the efficacy of various parameters of organ function

      (iv) improved methods for analyzing three-dimensional data generated by SPECT and PET, if these are not forthcoming commercially

4. Development and diagnostic applications of gamma-emitting radiopharmaceuticals

   (a) greater support for development of new or improved radiopharmaceuticals of Tc-99m including:

      (i) more complete understanding of the basic radiochemistry

      (ii) improved Tc-99m agents for brain SPECT imaging

      (iii) improved Tc-99m agents for myocardial imaging

   (b) better agents for imaging thrombi and atherosclerotic lesions

   (c) development of receptor-binding agents for more selective localization of various radionuclides in specific tissues or organs

   (d) better methods for labeling blood cellular components for research in cellular immunology

   (e) better bifunctional chelates for Tc-99m and other radioactive elements to conjugate monoclonal antibodies and other proteins

   (f) explore the radiochemical characteristics and labeling properties of intermediate half-life gamma emitters, such as Ru-97 and Pb-203

5. Greater support for the therapeutic applications of radionuclides, particularly for radioimmunotherapy with labeled monoclonal antibodies, metaiodobenzylguanidine (MIBG) for pheochromocytomas and other apudomas, palliation of severe synovitis in arthritides, palliation of osseous metastases, and non-systemic radiopharmaceutical delivery.

This research involves the production of radionuclides with optimum nuclear and chemical properties and their incorporation into radiopharmaceuticals, animal testing, and computer modeling for radiation dose estimates.

COMMENTS ON "SUMMARY RESULTS OF AN ASSESSMENT OF RESEARCH PROJECTS IN THE NUCLEAR MEDICINE RESEARCH PROGRAM"

The Subcommittee on Nuclear Medicine was provided copies of this study (DOE/ER-0360, January 1988) conducted by the Office of Program Analysis, Office of Energy Research. This document contains a section "Targets for Future Research" on which the Subcommittee wishes to comment. It agrees with most of the targets and activities recommended in this document, with the following notable exceptions:--

1b. Expanded research on in vivo applications of nuclear magnetic resonance spectroscopy for diagnosis. Although this is an interesting area of research, it is an extremely expensive modality for human studies, so that establishing even a token research program would severely impact the modest budgets of the Medical Applications Program. Such a major area of new research could be undertaken only with a new initiative and a sizable additional appropriation.

1c. Likewise, low level waste disposal technology is not a Medical Applications research problem, but an industrial environmental problem. The Medical Applications Program, and specifically nuclear medicine and its research, deals more and more with short-lived radionuclides, with minimal radioactive waste.

2d. Integration of radionuclide images with MRI, CT and other imaging procedures, the Committee believes, should be a commercial development rather than research supported by the DOE.

3e.& f. and other priority areas listed on page 12.

Research in neutron capture therapy, radiosurgery, magneto-encephalography and high temperature superconductors do not lie within the expertise of nuclear medicine scientists. The medical applications of these techniques should be peer-reviewed by an appropriate group.

On the other hand, this Committee heartily endorses recommendation 2f. calling for "long-term, stable core support to medically oriented production facilities, including research going beyond chemistry to produce the radionuclide, synthesize the ligand and test in a reasonable animal model".

APPENDIX

PHYSICAL CHARACTERISTICS OF RADIONUCLIDES CITED IN THIS REPORT

COMMON "SINGLE PHOTON" GAMMA EMITTERS USED IN NUCLEAR MEDICINE FOR IMAGING

Nuclide	Half-Life	Major X or γ emissions		β Emissions	Typical
		keV	External Photon Yield (%)	(MeV max)	Production
Ga-67	3.3d	93	38	0	Zn-68(p,2p)
		184	24		
		300	15		
		393	4		
		Others			
I-123	13.3h	159	83	0	Xe-124(p,2n)I-123
		530	2		Xe-123 or
		27(Te x-rays)	87		I-127(p,5n)^{123}Xe
I-131	8d	284	5	0.61	Fission
		364	82		
		637	7		
		723	2		
		Others			
In-111	2.8d	173	89	0	Ag-109(a,2n)
		247	94		
		23(Cd x-rays)			
Kr-81m	13 sec	190	65	0	Br-79(a,2n)Kr-81m or
		Kr x-rays			Kr-82(p,2n)Rb-81
Tc-99m	6h	140	90	0	Fission Mo-99
		18(Tc x-rays)	8		
Tl-201	3.1d	135	2	0	Tl-203(p,3n)Pb-201
		167	8		
		69-80(Hg x-rays)	93		
Xe-127	36d	145	4	0	
		172	22		Cs-133(p,2p5n)
		203	65		I-127(p,n)
		375	20		
		Others			
Xe-133	5.2d	81	37	0.346	Fission
		Cs x-rays			

COMMON "SINGLE PHOTON" GAMMA EMITTERS FOR NON-IMAGING DIAGNOSTIC STUDIES IN NUCLEAR MEDICINE

Nuclide	Half-Life	Major X or γ emissions		β Emissions	Typical
		keV	External Photon Yield (%)	(MeV max)	Production
Co-57	270d	122	87	0	Ni-60(p,α)
		136	11		
		Others			
Cr-51	27.8d	320	9	0	Cr-50(n,γ)
		(V x-rays)			
Fe-59	45d	1.09	56	1.57	Fe-58(n,γ)
		1.29	44		
		Others			
I-125	60d	35	7	0	Xe-124(n,γ)Xe-125
		27(Te x-rays)	136	0	
Se-75	120d	121	17	0	Se-74(n,γ)
		136	57		
		265	60		
		280	25		
		401	12		
		Others			

COMMON RADIONUCLIDES FOR THERAPY ONLY

Nuclide	Half-Life	Major X or γ emissions		β Emissions	Typical
		keV	External Photon Yield (%)	(MeV max)	Production
Au-198	2.7d	41	95	96	Au-197(n,γ)
P-32	14.3d	0	0	1.71	P-31(n,γ)

GAMMA EMITTERS POTENTIALLY USEFUL FOR IMAGING

Nuclide	Half-Life	Major X or γ emissions		β Emissions
		keV	External Photon Yield (%)	(MeV max)
Pb-203	2.2d	279	81	0
		401	3	
		680	7	
		(Tl x-rays)		
Ru-97	2.9d	216	86	0
		325	10	
		(other weak,Te x-rays)		

NEWER SHORT-LIVED (DAUGHTER) RADIONUCLIDE GENERATOR SYSTEMS

Daughter				Parent		
Nuclide	Half-Life (sec)	Principaly keV	% External photon yield	Nuclide	Half-Life	Typical Production
Ag 109	39	88	5	Cd 109	453d	Cd 108(n,γ)
Au 195m	31	261	77	Hg 195m	40h	Au 197(p,3n)
		Au x-rays				
Ir 191m	5	129	25	Os 191	16d	Os 190(n,γ)
Ta 178	561	55-63 x rays		W 178	21d	Ta 181(p,4n)

"PURE" BETA EMITTERS POTENTIALLY USEFUL FOR THERAPY

Nuclide	Half-Life	β Emissions (Mev max)
Er 169	9d	.34
Sc 47	3.4d	.60
Sr 89	52d	1.46
Y 90	2.7d	2.27

ALPHA EMITTERS POTENTIALLY USEFUL FOR THERAPY

Nuclide	Half-life	βEmissions	αEmission mev	X or γEmissions (meV)
At 211	7.2 hr	0	5.9(41%)	.67 (weak) (Po x rays)
Bi 212	1 hr	2.25(64%)	6.0(36%)	.727(7%) (other weak, Tl x rays)

BETA-GAMMA EMITTERS POTENTIALLY USEFUL FOR THERAPY

Nuclide	Half-Life	Major X or γ emissions		β Emissions
		keV	External Photon Yield (%)	(MeV max)
As-77	39 hr	239	2.5	.68
		Others		
Au-199	3.1d	158	37	.46
		208	8	.30
Cu-67	2.6d	91	7	.39
		93	16	.48
		184	49	.75
		300	.8	
		(Zn x-rays)		
Dy-165	2.3	95	4	1.29
		(Other weak, Ho x-rays)		
GD-159	18 hr	363	9	.95
		58	3	
Ho-166	27 hr	81	5	1.84
		(Other weak, Er x-rays)		
Ir-192	74d	317	81	.67
		468	49	
		(Others, Os & Pt x-rays)		
Ir-194	19 hr	328	10	2.24
		(Other weak)		
Pd-109	13 hr	88	5	1.03
		(Other weak, Pd x-rays)		
Pm-149	53 hr	286	2	1.07
Pr-142	19 hr	1570	4	2.16
Re-186	90 hr	137	9	1.07
		(Other weak, W & Os x-rays)		
Re-188	17 hr	155	10	2.12
		(Other weak, Os x-rays)		
Rh-105	36 hr	319	19	.568
		306	5	
Sm-153	47 hr	103	28	.80
		70	5	
		(Many other weak, Eu x-rays)		

COMMON POSITRON EMITTERS IN NUCLEAR MEDICINE

Nuclide	Half-Life min	Other X or γ emissions MeV	External Photon Yield (%)	β⁺ (MeV max)	%	Typical Production
C-11	20			.96	100	B-10 (d,n)
N-13	10			1.2	100	C (d,n)
O-15	2			1.7	100	N-. (d,n)
F-18	110	(O x-rays	3	.63	97	Ne-20(d,α) or O-18(p,n)
Ga-68	68	1.08 (weak γ's,Zn x-rays)	3	1.9 .82	88 1	Ga-69(p,2n)Ge-68
Rb-82	1.3	.77 (Kr x-rays)	14	3.1 2.4 Others	83 12	Rb-85(p,4n)Sr-82 Mo(p,spall)

LESS COMMON POSITRON-EMITTERS

Nuclide	Half-Life	Other X or γ emissions MeV	External Photon Yield (%)	β⁺ (MeV max)	%	Typical Production
As-72	26 hr	.83	78	3.3	17	As-75(d,5n)Se-72
		.63	8	2.5	58	
		(Other weak,Ge x-rays)				
As-74	18d			.94	26	Ga-71(α,n)
				1.5	3	
				(β .72)	(β 15)	
				(β 1.3)	(β 19)	
Br-75	98 min	.29	92	1.74	51	Kr-78(p,α)
		.14	7	Others	25	
		(Other weak,Se x-rays)				
Co-55	18 hr	.93	80	1.5		Fe-56(p,2n) Fe-54(d,n)
		1.4	13			
		.48	12			
		(Fe x-rays)				
Cu-61	3.3 h	.284	12	1.22	60	Ni-60(d,n)
		1.19	5			
		(Other weak,Ni x-rays)				
Cu-62	9.9m			2.9	97	Co59(α,n)or Ni-62(p,n)
Cu-64	13 hr	1.3	.5	.66	18	Cu-63(n,γ) or
		(Ni x rays)		(β .578)	(β 37)	Zn-64(n,p)
Zr-89	79 h	.91	99	.9	22	Y-89(p,n)
		1.71	1			
		(Y x-rays)				

TABLE OF THE ELEMENTS

Element	Symbol	Atomic Number	Atomic Weight	Element	Symbol	Atomic Number	Atomic Weight
Actinium	Ac	89	(227)	Mercury	Hg	80	200.59
Aluminum	Al	13	26.98	Molybdenum	Mo	42	95.94
Americium	Am	95	(243)	Neodymium	Nd	60	144.24
Antimony	Sb	51	121.75	Neon	Ne	10	20.183
Argon	Ar	18	39.948	Neptunium	Np	93	(237)
Arsenic	As	33	74.92	Nickel	Ni	28	58.71
Astatine	At	85	(210)	Niobium	Nb	41	92.91
Barium	Ba	56	137.34	Nitrogen	N	7	14.007
Berkelium	Bk	97	(249)	Nobelium	No	102	(253)
Berylium	Be	4	9.012	Osmium	Os	76	190.2
Bismuth	Bi	83	208.98	Oxygen	O	8	15.9994
Boron	B	5	10.81	Palladium	Pd	46	106.4
Bromine	Br	35	79.909	Phosphorus	P	15	30.974
Cadmium	Cd	48	112.40	Platinum	Pt	78	195.09
Calcium	Ca	20	40.08	Plutonium	Pu	94	(242)
Californium	Cf	98	(251)	Polonium	Po	84	(210)
Carbon	C	6	12.011	Potassium	K	19	39.102
Cerium	Ce	58	140.12	Praseodymium	Pr	59	140.91
Cesium	Cs	55	132.91	Promethium	Pm	61	(147)
Chlorine	Cl	17	35.453	Protactinium	Pa	91	(231)
Chromium	Cr	24	52.00	Radium	Ra	88	(226)
Cobalt	Co	27	58.93	Radon	Rn	86	(222)
Copper	Cu	29	63.54	Rhenium	Re	75	186.23
Curium	Cm	96	(247)	Rhodium	Rh	45	102.91
Dysprosium	Dy	66	162.50	Rubidium	Rb	37	85.47
Einsteinium	Es	99	(254)	Ruthenium	Ru	44	101.1
Erbium	Er	68	167.26	Samarium	Sm	62	150.35
Europium	Eu	63	151.96	Scandium	Sc	21	44.96
Fermium	Fm	100	(253)	Selenium	Se	34	78.96
Fluorine	F	9	19.00	Silicon	Si	14	28.09
Francium	Fr	87	(223)	Silver	Ag	47	107.870
Gadolinium	Gd	64	157.25	Sodium	Na	11	22.9898
Galium	Ga	31	69.72	Strontium	Sr	38	87.62
Germanium	Ge	32	72.59	Sulfur	S	16	32.064
Gold	Au	79	196.97	Tantalum	Ta	73	180.95
Hafnium	Hf	72	178.49	Technetium	Tc	43	(99)
Helium	He	2	4.003	Tellurium	Te	52	127.60
Holmium	Ho	67	164.93	Terbium	Tb	65	158.92
Hydrogen	H	1	1.0080	Thalium	Tl	81	204.37
Indium	In	49	114.82	Thorium	Th	90	232.04
Iodine	I	53	126.90	Thulium	Tm	69	168.93
Iridium	Ir	77	192.2	Tin	Sn	50	118.69
Iron	Fe	26	55.85	Titanium	Ti	22	47.90
Krypton	Kr	36	83.80	Tungsten	W	74	183.85
Lanthanum	La	57	138.91	Uranium	U	92	238.03
Lawrencium	Lw	103	(257)	Vanadium	V	23	50.94
Lead	Pb	82	207.19	Xenon	Xe	54	131.30
Lithium	Li	3	6.939	Ytterbium	Yb	70	173.04
Lutetium	Lu	71	174.97	Yttrium	Y	39	88.91
Magnesium	Mg	12	24.312	Zinc	Zn	30	65.37
Manganese	Mn	25	54.94	Zirconium	Zr	40	91.22
Mendelevium	Md	101	(256)				

Mr. Bevill. The Committee expressed strong support of the nuclear medicine program and particularly the Positron Emission Technology (PET) project. Please discuss the status of the work in this area and provide the FY 1989, FY 1990 and FY 1991 budget requests.

Dr. Decker. Positron emission tomography is a well-established technique for investigating the physiological and biochemical properties of tissues in vivo. While the technique has been used primarily for investigational studies of the heart and brain, it now is becoming established as a clinical tool. It shows promise of having a significant impact in diagnosing and treating diseases such as epilepsy, stroke, brain tumors, and dementia. PET's potential is expanding. The technology makes possible the quantification of regional chemistry within the living human body to an extent not otherwise possible.

New research on PET technology will continue to increase its role in nuclear medicine as well as in biologic science. Major factors that will accelerate the use of PET technology in clinical medicine include the development of simple, computer-operated cyclotrons, high resolution imaging devices and better quantification of the radioactivity concentrations through chemical models.

Funding profiles for the program in Fiscal Years 1989, 1990, and 1991, are $10.2 million, $10.1 million, and $10.7 million, respectively.

Mr. Bevill. Please discuss the DOE program in Global Warming research and describe the present and expected future results of the program.

Dr. Decker. The Carbon Dioxide Research Program (CDRP) is DOE's program in Global Warming research. The Program is also DOE's main entry in the U.S. Global Change Research Program which is coordinated by the interagency Committee on Earth Sciences of the Office of Science and Technology Policy. I would like to provide for the record a description of the principal components of the program. (The information follows:)

CARBON CYCLE

Research addresses the global sources and sinks of carbon dioxide and other greenhouse gases. In FY 1991 DOE will continue the development of an operational carbon cycle model which includes the ocean-atmosphere and biosphere-atmosphere carbon dioxide exchanges. The model will be applied to scenarios of global energy emissions. Natural and anthropogenic feedbacks between the global carbon system and climate will be identified and natural processes (e.g. reforestation) and biotechnology will be examined as ways to slow the rate of carbon dioxide increase in the atmosphere.

CLIMATE MODELLING DIAGNOSTICS

This component includes the intercomparison of the principal climate change prediction models as well as the comparison of their results with climatic records. This intercomparison examines the principal causes for the differences among the models as well as identifies the crucial areas for improvement. In FY 1991 this activity will continue to test model validity on select cases of regional interannual variability, expand data bases over long time periods and multiple climate elements and study the effects of increased model resolution on climate change predictions.

Starting in FY 1990 and continuing into FY 1991 the Carbon Dioxide Research program is making an investment into the next generation supercomputer within the DOE supercomputer network. This will make available large portions of supercomputing time for climate change simulations. A major product of this activity is a determination of the feasibility of climate change predictions as well as the spatial and temporal constraints of these predictions.

Also starting in FY 1990 and expanding in FY 1991 is the Computer Hardware, Advanced Mathematics and Model Physics (CHAMMP) Program. CHAMMP will capitalize on new innovative computer architectures (e.g. massively parallel designs and thinking machine concepts) and enhanced software developments to produce the Advanced Climate Model (ACM). With an anticipated increase of computing throughput of approximately 10,000, ACM will address climate change prediction at the regional level.

OCEANS RESEARCH

This component provides the ocean carbon measurements in support of the international World Ocean Circulation Experiment (WOCE). The research will improve our understanding of the ocean's ability to store and transport carbon by studying the ocean's biology and the climate feedback on ocean biology. The program will expand research in FY 1991 with fine grid ocean modeling to address the formation of deep water.

QUANTITATIVE LINKS

Starting in FY 1990 and continuing into FY 1991 experimental studies have been launched to quantify the links between the rise of greenhouse gases in the atmosphere and climate change. An example is the sound propagation field program to identify an ocean warming signal.

Also starting in FY 1990 is the Atmospheric Radiation Measurement (ARM) Program. ARM involves the acquisition of high resolution radiation measurements in the atmospheric column as well as the vertical profiles of the atmospheric properties responsible for this balance. A total of six permanent experimental sites and one mobile site is planned. ARM is expected to greatly improve the fundamental understanding of the cloud-climate feedback mechanism and reflect this understanding in the next generation climate models. Testing and improvement of ground-based remote sensing systems and the preparation of the first fixed site will dominate activities during FY 1991.

VEGETATIVE EFFECTS

This component includes experimental research and modeling to determine the simultaneous influence of increased atmospheric carbon dioxide and climate change on selected plants, with emphasis on photosynthesis and growth in relation to variable carbon dioxide and temperature. A major field study, in FY 1991, will control and manipulate ecological, atmospheric and other environmental conditions to provide validation information for ecological models with the ultimate goal of discovering ways to accelerate carbon dioxide removal from the atmosphere.

RESOURCE ANALYSIS AND EDUCATION

Studies will concentrate on developing methodologies to identify resources that are in jeopardy from climate change. Current emphasis is on the Midwestern United States. In FY 1991 the work will expand to include other U.S. regions, China and Western Europe.

In FY 1991 DOE will launch a major educational initiative to train the next generation of scientists involved in global change. The initiative will include both graduate and postgraduate fellowships as well as the development of special science curricula (K-12) and the training of science teachers at the DOE national laboratories.

INFORMATION AND INTEGRATION

The DOE Carbon Dioxide Information and Analysis Center at Oak Ridge National Laboratory will continue to compile, evaluate and distribute carbon dioxide and climate information. The Center identifies research needs for data, models and information; obtains, evaluates and validates the data; and works with other national and international data centers to promote useful data exchanges.

The Carbon Dioxide Research program also supports the Department's role in the Intergovernmental Panel on Climate Change and, in particular, the activites related to science assessments.

Mr. Bevill. Provide the FY 1989, FY 1990 and FY 1991 budgets for carbon dioxide research.

Dr. Decker. The budget for FY 1989 was approximately $17.4 million. The budget planned for FY 1990 is $50.0 million and the budget requested for FY 1991 is $65.9 million for carbon dioxide research.

Mr. Bevill. Please describe your human genome program.

Dr. Decker. The Department's human genome program is aimed at developing the biological and technical tools that are needed to describe the human genome at the molecular level. To accomplish this, we have three major objectives. These are the development of methods and instruments to carry out the large scale mapping and sequencing of DNA, the construction of physical maps for each of the 24 different human chromosomes made up of ordered DNA fragments, and the development and improvement of necessary database management and analysis tools. Two additional areas which are receiving emphasis in support of attainment of these objectives are technology transfer and ethical, legal, and social aspects of the program. Our two Human Genome Centers are located at the Los Alamos National Laboratory and the Lawrence Berkeley Laboratory. A third major multidisciplinary effort is also underway at the Lawrence Livermore National Laboratory, and we have important research activities at other national laboratories, universities and in the private sector.

Mr. Bevill. What is the expected total cost of the human genome program and what is the DOE portion?

Dr. Decker. The Department's Health and Environmental Research Advisory Committee (HERAC) report issued in April 1987 on the Human Genome Initiative recommended incremental funding for the national project that would level off in year five at $200 million per year and continue for at least three additional years. There were subsequent reports from the National Research Council and the Congressional Office of Technology Assessment that supported the HERAC report by endorsing a major effort at the sustained level of $200 million per year. The funding profiles for the two Federal agencies with human genome programs will be provided for the record. (The information follows:)

FUNDING PROFILES
(IN MILLIONS OF DOLLARS)

	Fiscal Year				
	1987	1988	1989	1990	1991
DOE	$5.5	$10.7	$17.5	$26.0	$ 45.9
NIH	$ 0	$17.2	$27.6	$59.5	$108.0
Total	$5.5	$27.9	$45.1	$85.5	$153.9

Mr. Bevill. What other agencies are involved in the "human genome" activity and how is the work coordinated?

Dr. Decker. The two Federal agencies with human genome programs, the National Institutes of Health and the Department of Energy, have signed a Memorandum of Understanding to facilitate cooperation and coordination of genome research and related activities. This Memorandum establishes a joint advisory committee made up of experts working in the field and an interagency working group made up of staff of each agency to help coordinate research. Additional coordination is accomplished through informal meetings between representatives of two other major sponsors, the NSF and the Howard Hughes Medical Institute, both of which support genome-related research. The Hughes Institute also hosts these informal meetings on a bimonthly basis. DOE and NIH have drafted a five-year plan which describes optimal strategies for utilizing each agency's complementary strengths to achieve commonly accepted aims. The Department of Agriculture is now initiating a plant genome program and has, therefore, been invited to join the other organizations in these informal meetings.

Mr. Bevill. What is the status of the Department's research work on the effects of radon?

Dr. Decker. The $15 million DOE radon research program, now in its third year, supports a mixture of basic and applied research at universities and national laboratories. It involves over 60 projects ranging from instrumentation development, geological transport, indoor aerosol characterization, respiratory deposition and dosimetry, animal inhalation and uranium miner epidemiology studies, to basic molecular and cellular radon carcinogenesis studies. The overall program goal continues to be to provide a firm scientific basis for the assessment of indoor radon exposure, its risk and control. It has been very productive both in terms of scientific publications, scientific leadership, and accomplishments, as well as a series of program publications.

Mr. Bevill. How are the results of your research being disseminated to the general public and is it timely?

Dr. Decker. Scientific results are disseminated at national and international meetings, in scientific journals, through national academy panels, and technical books. In addition, the program is supporting discipline-oriented workshops at professional scientific meetings and is initiating a radon research newsletter with over 3,000 on the distribution list which includes state and local radiation officials. The program publishes technical manuscripts three to four times per year and an annual program summary booklet with a wide distribution. In addition, EPA and DOE have worked together to compile and distribute a summary of Federal radon research activities.

Mr. Bevill. In FY 1990, the Congress initiated a program to establish a National Institute on Global Environmental Change. What is the status of the Institute and what are your plans for this Institute in FY 1991?

Dr. Decker. We have received an informal proposal from the University of California at Davis (UC-Davis) describing the management plan for the National Institute on Global Environmental Change (NIGEC). Members of my staff have consulted with UC-Davis representatives to ensure that the proposed NIGEC structure is acceptable to DOE. We expect to receive the official proposal during the next few weeks and a Cooperative Agreement with UC-Davis may be in place by May 1990.

We have also received a series of informal research mini-proposals from several of the universities associated with NIGEC. My staff has provided some guidance regarding their relevance to DOE research interests.

We expect that UC-Davis will serve as the National Center of NIGEC. NIGEC will have four Regional Centers represented by Harvard University, Tulane University, Indiana University and the University of California at Davis. All U.S. universities will have the opportunity to submit proposals to one of the Regional Centers as well as to the UC-Davis National Center. Scientific proposals will be funded based on a peer-review process and DOE concurrence. The NIGEC Cooperative Agreement will be under the programmatic purview of the Atmospheric and Climate Research Division within the Office of Health and Environmental Research. A part of the NIGEC activities will support the DOE Office of Policy, Planning and Analysis. NIGEC will be funded at the level of $5.9 million in FY 1990. The projected funding for FY 1991 is $6.0 million.

Mr. Bevill. Describe your expanded genome research with emphasis on innovative sequencing technologies and advanced computational capabilities.

Dr. Decker. Advances in the DOE human genome program were presented at the first grantee/contractor workshop for projects supported by the program in November 1989. One of the most exciting innovative approaches to DNA sequencing is being developed at the Los Alamos National Laboratory where researchers are coupling automated flow cytometry with appropriate fluorescent tags for each of the four DNA nucelotides. Several companies are collaborating with the laboratory in developing this technology which has the potential for becoming a truly revolutionary approach to determining the sequence of the subunits of DNA and other macromolecules such as RNA and proteins.

Each of the three larger DOE multidisciplinary projects at the Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and Lawrence Berkeley Laboratory are developing computational capabilities in support of their mapping efforts. In addition, other investigators are developing electronic notebooks that will allow scientists sitting at their personal computers to enter mapping and sequencing data directly into databases, retrieve and analyze it using appropriate software. Some of these allow the user to "zoom" several orders of magnitude in resolution from gross chromosomal structure down to molecular level mapping and sequencing information.

Mr. Bevill. How much is in your budget for the U.S. share of the design of the Engineering Test Reactor and how are you assured that the total costs are being shared equally?

Dr. Decker. We have requested $16 million in the FY 1991 budget for continuation of the U.S. portion of the design and supporting R&D for the joint work on the international engineering test reactor called the International Thermonuclear Experimental Reactor or ITER.

The matter of sharing costs equally is an important one that was addressed at the outset of the ITER work some three years ago. The Terms of Reference, which govern the Parties involvement in ITER, state in Article 1 that the Parties will be "making equal contributions". Article 5.1.2 on Functions states that the ITER Council, the governing body, will "ensure equal contributions of the Parties to the execution of the Conceptual Design Activities". Finally, Article 5.2.2 on Functions states that the ITER Management Committee, the operating body, will "assign tasks within the programme of work to provide for equivalence of contribution by each Party".

The Terms of Reference go on to specify the overall levels of contribution in both the design and R&D areas. Over the two years of joint work thus far completed, the ITER Management Committee has developed detailed work plans with equal contributions from each Party. These work plans and the actual work contributions are fully open and seen by all participants. The Management Committee and the Council believe that the process is working and that each Party is providing its quarter of the committed resources.

Mr. Bevill. What is the estimated cost of the design of the Engineering Test Reactor?

Dr. Decker. The cost of design and related R&D for the International Thermonuclear Experimental Reactor (ITER) Conceptual Design Activity, scheduled to be completed in December 1990, is about $200 million, shared equally among the four participating Parties, including the European Community, Japan, the Soviet Union, and the United States. We are presently considering entering discussions to define an engineering design activity. The cost estimate for the performance of the engineering design and associated R&D for ITER is being developed.

Mr. Bevill. What is the earliest that you would anticipate commercialization of magnetic fusion?

Dr. Decker. I am encouraged by the steady progress that has been made by the magnetic fusion program. While a number of factors could affect the schedule for achieving this goal, I believe that with a new strategy, clear milestones, good management, and adequate resources, fusion can be developed by 2025.

Mr. Bevill. Describe the Compact Ignition Tokamak (CIT) program plan and explain the CIT's role in the magnetic fusion program.

Dr. Decker. The role of CIT in the fusion program is to investigate the physics of self-heated, burning fusion plasmas. This is the most immediate of four key technical issues facing the fusion program and cannot be accomplished without a new experimental facility such as CIT. CIT will also generate substantial quantities of fusion power and thereby provide important information on the engineering of tokamak reactor systems. A reassessment of the CIT project role objectives, and scope will be provided to Fusion Policy Advisory Committee this spring for their consideration in formulating a recommended fusion program strategy. Should the Fusion Policy Advisory Committee recommend proceeding with CIT, the earliest the project could restart would be FY 1992 and construction completion and operation would be in 1998. Design and R&D in support of the CIT concept are planned to continue in FY 1991 using $16.8 million in operating funds.

Mr. Bevill. Why are funds not included for construction of the CIT?

Dr. Decker. The CIT Project was originally proposed in the FY88 budget for construction completion and operation in 1993. In 1989, Admiral Watkins requested that CIT construction funding be deferred due to concerns about the probability of ignition and the need to better understand the physics of plasma confinement. A reassessment of the CIT objectives, scope and ignition capability is now under way. The fusion program has also been pursuing, since early 1989, concentrated research on plasma confinement and the mechanisms controlling energy transport. The results of both the CIT objective reassessment and the transport initiative will be presented to a Fusion Policy Advisory Committee this spring. This Fusion Policy Advisory Committee was chartered to advise DOE on the proper strategy for developing fusion energy. Decisions concerning CIT and other elements of the fusion program will be based on advice from the Fusion Policy Advisory Committee.

Mr. Bevill. In addition to the design of the Engineering Test Reactor, what role will collaboration of foreign governments play in FY 1991?

Dr. Decker. Beyond any joint work in ITER that may be agreed to by the U.S. and the other Parties, the U.S. program has a large number of collaborative activities in place. In fact, we have some thirty agreements, both umbrella and specific task agreements, in place with the major and smaller programs around the world. Under these agreements for mutually beneficial activities, we have received strong technical contributions and financial support from the Japanese for our operating facilities in both science and fusion technology. These facilities included the Doublet-III-D facility in General Atomics, the TSTA tritium handling facility in Los Alamos, and various materials irradiations facilities in Livermore, Oak Ridge and Hanford. We expect much of that support, which amounts to half the operating costs for these technology facilities, to continue into FY 1991. We have also participated closely in major European Community fusion experiments, namely, JET in the U.K., Tore Supra in France, TEXTOR and ASDEX-Upgrade in the FRG, in lieu of having to construct such facilities ourselves. We expect to continue these activities into FY 1991 as well. These activities have been developed over the last ten to fifteen years in order to maximize the usefulness of our domestic research expenditures. As a result, our program breadth and depth have become dependent upon these interactions with the other countries' programs. International collaboration has become an essential ingredient in our current program.

Mr. Bevill. What program activities will be involved in this foreign collaboration? What countries are involved?

Dr. Decker. All of our major program activities are involved in international cooperation or collaboration at this time. We have developed umbrella agreements and specific tasks assignment agreements with the major programs in the European Community, Japan and the Soviet Union. We also have similar arrangements, on a smaller scale, with the Canadian and Chinese fusion programs. As a part of larger Science and Technology agreements, we also have a few specific, modest sized tasks with the programs in Israel and Yugoslavia, and are discussing other modest tasks with the programs in Brazil and India.

These activities include science and technology topics across the board in the magnetic fusion energy program. They involve both joint work on unique facilities such as the major tokamaks in the European Community and joint irradiations on U.S. fission reactor devices, and coordinated programs involving comparable facilities in the U.S., Japan, and the European Community such as on the operation of the three large tokamaks, and the stellarator experiments. Each of these interactions is carefully examined for its budget and technology transfer aspects before being negotiated.

Mr. Bevill. What is the total value or cost to the U.S. of these collaborative arrangements?

Dr. Decker. It is very difficult to give a simple answer to this question. Our involvements with the major facilities in the other programs give us detailed access to investments totaling more than $1.5 billion dollars. In the billion dollar level, the Joint European Torus facility located in Culham, U.K., we have contributed hardware components and personnel costing us a few million dollars in return for which we are co-managers of a critical experiment using our particle injection device and have negotiated full access to important data. Similarly, in the multihundred million dollar European facilities in France, Tore Supra, and in Germany, ASDEX Upgrade and TEXTOR, we have also made modest but important contributions of hardware and personnel in return for indepth participation in the experiments. Japan contributed over $70 million and skilled scientists to support continuing world performances at DIII-D and $2 million a year to achieve full utilization of Tritium Systems Test Assembly.

Beyond these collaborations associated with major facilities, we have many personnel involvements at workshops, long-term participations, reviews, etc. These costs are on the order of one or two percent of our overall budget and permit our scientists and engineers to understand the latest thinking of skilled people around the world. We believe these modest costs are clearly balanced by the benefits received into the U.S. magnetic fusion program.

Mr. Bevill. Describe the activities at the Doublet III-D facility and describe the contribution of this effort to the overall Magnetic Fusion program.

Dr. Decker. DIII-D is currently engaged in research on understanding physics of improved confinement regimes in tokamaks and optimization of the plasma pressure within the confining magnetic field. DIII-D has led the world in the investigation of the latter issue. Tokamak heating and current drive using high power microwaves also receive emphasis as a part of the DIII-D program.

DIII-D has proven to be the major contributor to the U.S. physics research and development in support of the international collaboration on ITER. It should also be noted that the Japanese fusion community still maintains an ongoing effort in support of the DIII-D that began with its substantial participation in DIII-D's construction.

Mr. Bevill. Why would the delay in the "burning" of Deuterium-Tritium in TFTR contribute to increased understanding of confinement physics?

Dr. Decker. TFTR has the best set of plasma diagnostics and the largest amount of auxiliary heating power of any tokamak in the U.S. The intense D-T preparations under way at the time the transport initiative began would have prevented TFTR from adding any new transport diagnostics or dedicating a significant amount of operating time to transport studies. Because of TFTR's considerable capability to contribute to transport studies and because an increased understanding of transport could improve the D-T operating phase on TFTR, it was decided to focus TFTR resources on the transport issue and to delay D-T operation in TFTR.

Mr. Bevill. Describe the rationale of the delay in Deuterium-Tritium burn in TFTR.

Dr. Decker. Developing a more complete understanding of enhanced confinement regimes in tokamaks and improved techniques for predicting the performance of future tokamaks could reduce the uncertainty in the design of future tokamaks such as CIT and ITER. Since TFTR has the best set of diagnostic instruments and the greatest amount of auxiliary heating power in the U.S. fusion program, it was logical that it be a major resource in the transport initiative along with DIII-D and TEXT. Since dedicated preparations for D-T operation in TFTR would not be compatible with transport studies, since TFTR D-T experiments would benefit from increased transport understanding, and since additional resources were needed for transport studies, it was decided to postpone D-T operation in TFTR.

Mr. Bevill. Your FY 1991 budget completes the Alcator C-MOD. Please describe this facility and indicate its contribution to the overall program.

Dr. Decker. The Alcator C-MOD is the natural extension of the pioneering MIT high field compact tokamak program. It integrates modest elongation of the plasma cross-section with improved impurity control systems, while retaining the high magnetic fields of its predecessors. In addition to allowing the study of confinement of high density, high magnetic field plasma, it will also be used to investigate the control of plasma profiles for enhancing stability and confinement.

Mr. Bevill. Describe the operation and programmatic contribution of the PBX-M facility.

Dr. Decker. Operation of the PBX-M device was suspended for most of the current fiscal year to permit facility improvements. There will be no experimental operations until the beginning of FY 1991 when PBX-M will come back on line to resume its program of precise plasma control and shaping leading to attainment of the theoretically predicted second region of stability for tokamaks. Such a regime would considerably enhance the tokamak's performance as a fusion reactor.

Mr. Bevill. When can the Committee expect the results of the review by the Fusion Policy Advisory Committee?

Dr. Decker. Admiral Watkins announced the membership of the 19 member Fusion Policy Advisory Committee on March 5. Their first meeting, which will be open to the public, will be held on March 22 and 23. The Fusion Policy Advisory Committee will provide the Department with a final report by the end of September. I will be happy to share this report with Members of the Committee.

Mr. Bevill. Describe the need for the Confinement Physics Research Facility and what is the status of the facility?

Dr. Decker. The purpose of the Confinement Physics Research Facility (CPRF) is to provide a magnetic fusion research facility that is capable of exploring the physics properties of a toroidal confinement concept that has the potential, in future devices, of ohmic heating to ignition with low magnetic fields.

The first experimental device to be constructed in the CPRF is ZTH, a reversed field pinch configuration. It is scheduled for completion in 4th quarter 1993. The project is 66% complete. The project cost is under review. In response to a Magnetic Fusion Advisory Committee recommendation, a review of the program's scientific status was conducted during February and this review provided a strong endorsement of the project and its proposed research program.

Mr. Bevill. What experimental work remains to be done at TFTR? How long do you anticipate operating this facility?

Dr. Decker. TFTR will complete approximately one more year of transport studies and then continue directly to a period of operation aimed at achieving equivalent breakeven (the condition where the fusion power produced in a D-T plasma would be equal to the power required to heat the plasma) in deuterium plasmas. This work should be completed by the end of 1991. At this point, if FPAC endorses such a program and funding is provided, TFTR would be able to return to intensive preparations for D-T operation.

Mr. Bevill. Please describe the anticipated foreign investment in the Compact Ignition Tokamak (CIT).

Dr. Decker. The CIT project is presently planned as a U.S. Program, however, there is considerable international interest in the results from such a device. We would anticipate some foreign collaborations on diagnostics, heating, or auxiliary systems, but these possibilities cannot be adequately explored prior to a clear indication that the U.S. is proceeding with the project.

Mr. Bevill. Would the Compact Ignition Tokamak be the next step in the fusion program if the work on the Engineering Test Reactor was not to continue?

Dr. Decker. Investigating the science of burning fusion plasmas is one of the four key technical issues for fusion. CIT is a physics experiment aimed at the first achievement and study of a burning plasma, whereas ITER is aimed at engineering issues and at control of long-pulse or steady-state burning plasma. Studying the physics of a burning plasma in a timely manner will provide the more complete physics understanding needed for the design and operation of future devices. An experimental facility, such as CIT, is the appropriate next step for the U.S. fusion program independent of progress on an Engineering Test Reactor.

Mr. Bevill. What is the DOE budget in FY 1989, FY 1990, and FY 1991 leading to development of innovative new fusion designs such as Tokamak, Stellarator, Reversed Field Pinch, Alcator C-Mod, Microwave Tokamak Experiment and D-III-D?

Dr. Decker. In the category of innovation we usually include the Advanced Toroidal Facility, Princeton Beta Experiment, Advanced Fusion Concepts, and some small tokamaks. The Alcator C-Mod, Microwave Tokamak Experiment and Doublet-III-D are considered base tokamaks. I would like to supply a table for the record that shows the budgets for innovative devices as well as the larger base tokamak devices. (The information follows:)

MAGNETIC FUSION DEVICES

Innovative Device	BA ($M) FY 89	FY 90	FY 91
Princeton Beta Experiment (PBX - tokamak)	10.4	4.9	11.0
Advanced Toroidal Facility (ATF - stellarator)	13.4	12.4	13.3
Reversed-Field Pinch	2.3	2.9	3.2
Compact Toroids	9.2	7.7	7.7
Base Devices			
Alcator C-Mod	15.6	15.2	15.1
Microwave Tokamak Experiment	12.0	9.4	9.4
Doublet-III-D	35.2	34.5	34.0
Tokamak Fusion Test Reactor	67.7	61.6	59.1

Mr. Bevill. Describe the role of new innovative fusion designs in the overall fusion program.

Dr. Decker. The fusion program is organized around four key technical issues. One of these is to determine the best confinement configuration for an economic, environmentally sound, and safe energy producing reactor. This is pursued by studying potentially improved devices. The devices include improvements in the tokamak, or other toroidal configurations such as the stellarator, or the reversed field pinch.

These new innovative fusion designs offer particular technological advantages in reactor embodiments. They all seek to offer high power density within the plasma and consequently efficient use of magnetic fields. Each of these configurations provides a different physical environment in which magnetically confined plasma obeys the same overall physical laws governing plasma stability and the transport of energy and particles within the plasma. Thus, the study of these different configurations can provide both potentially more attractive reactor configurations and unique insights valuable to the understanding of the general behavior of magnetically confined plasma.

Mr. Bevill. Do you believe there should be closer integration of magnetic and inertial confinement fusion programs?

Dr. Decker. It is possible that closer integration in the area of energy applications might be helpful to both programs. I believe that both programs are presently working effectively toward their goals under the current structure. The Fusion Policy Advisory Committee (FPAC) may recommend a different organizational structure or different goals for one or both programs. It would be appropriate to review the organization of the two programs, in the light of the FPAC recommendations that will be made in September of this year.

Mr. Bevill. Do you believe there should be funding for ICF work in the civilian energy research programs?

Dr. Decker. I believe that the appropriate level of support for ICF work in the civilian energy research is one of the issues that will be carefully considered by the Fusion Policy Advisory Committee. I would prefer not to answer this question until FPAC has had the opportunity to complete its review.

SUPERCONDUCTING SUPER COLLIDER

Mr. Myers. The Subcommittee is deeply concerned over the uncertainty expressed by Admiral Watkins regarding the total estimated cost of the SSC. He discussed increases in the $1-2 billion range. Can you provide any additional details on changes in the total estimated cost and when a new projection will be available to Congress?

Dr. Decker. The total project cost for the SSC is now estimated to be $1-2 billion higher than the $5.9 billion based on the 1986 design and cost estimate and shown in the FY 1990 budget request. This increase is primarily due to design changes made by the new SSC Laboratory staff which will reduce the technical risk for the successful completion of the project and reduce the time needed to commission the SSC. About two-thirds of the cost increase is associated with design changes such as increased injector energy, larger magnet aperture and increased collider circumference, and one-third associated with updated cost estimates based on items such as labor rates. The Laboratory is now finalizing its design and cost estimate, which will be reviewed indepth by the Department. A final validated cost estimate is expected sometime this summer.

Mr. Myers. What efforts does the Department have underway to provide information to the general public on the purpose of the SSC? Are any DOE "outreach" efforts planned?

Dr. Decker. Currently there is an educational display on site at the SSC Laboratory concerning the program and the science surrounding this project. This display is used to inform visitors. The Department is also working with the Texas National Research Laboratory Commission (TNRLC) which has an extensive education and outreach program concerning this project to address questions and concerns of residents in the Ellis County, Texas, area where the SSC will be located. The Department makes available fact sheets and pamphlets concerning the SSC. Contacts with the Department from the general public requesting information on the SSC are answered with these pamphlets and other information. The Department also works with and provides information to industry associations and the university community using pamphlets and fact sheets on the SSC. We are continuously updating this information.

Outreach efforts are currently underway with minority contractors and universities through the SSC Laboratory, as is the effort to work with the education community to make the SSC a science education resource.

Mr. Myers. Please update the Subcommittee on the status of the SSC magnet research, testing, and industrialization programs.

Dr. Decker. Satisfactory field strength and quench performance has been achieved and program emphasis is now on manufacturability and field quality. The mechanical problems plaguing the early full-length magnets have been understood and a number of full-length, 4 centimeter, magnets have now gone to full field with little or no training. Concern had been expressed earlier about the "margin" needed in these magnets. The magnets already have a margin of about 4 percent. The better superconducting wire now becoming available will help increase the margin. If additional margin is needed, it can be readily obtained by dropping the operating temperature a few tenths of a degree. The 5 centimeter bore magnets will have somewhat larger forces, but the magnet design should be a straightforward scale-up from the 4 centimeter design.

Five identical 4 centimeter magnets are now being constructed on second generation tooling and will be tested to improve understanding of manufacturing tolerances. In addition, seven magnets are being constructed and tested to provide insight into superconductor and insulation specifications.

Design of the 5 centimeter magnet has been initiated to provide enhanced field characteristics. Initial assembly will commence in FY 1990 with significant testing through mid-FY 1991. Superconducting accelerator magnets of design similar to the SSC have been successfully manufactured by European firms for the new Hadron Elektron[illegible]ng Anlage (HERA) facility in Germany. Several U.S. firms also appear to have the capability for making these magnets

reproducibly. The next step in the SSC magnet industrialization program is to bring industry's manufacturing expertise to bear in the final development stages to ensure cost-effective and reliable manufacture of these magnets.

Acquisition strategy for superconducting magnet industrialization has been developed. This provides for up to five separate vendors of the various types of magnets needed for the collider and high energy booster. Vendors will be selected through a competitive process. We expect that the first contract for collider dipoles will be let late this summer. Other magnet vendors will be chosen and their activities underway by the end of FY 1991.

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Mr. Myers. Does the fiscal 1991 budget request for the SSC include funding for any tunnel work? Please elaborate.

Dr. Decker. The fiscal year 1991 budget request for the SSC does not include funding for any tunnel work. It is not expected to begin tunnel construction until a decision has been made to go to commercial production of the superconducting magnets.

RELATIVISTIC HEAVY ION COLLIDER

Mr. Myers. The fiscal 1991 budget request includes funding to start construction of the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Lab. What is the nature of this project and how does it fit into the Department's research programs?

Dr. Decker. RHIC will be a unique, world-class research facility with opposing colliding beams that provides collision energies of 100 GeV/Nucleon per beam for heavy ions as massive as gold. The new accelerator will be built in the existing Colliding Beam Accelerator (CBA) tunnel (3.8 km circumference), and will utilize the experimental halls, support building, and liquid helium refrigerator from the partially completed CBA project. The collider consists of two rings of superconducting magnets for accelerating and storing beams at variable energies up to 100 GeV/Nucleon for the heaviest ions. For decades, researchers using particle accelerators have considered high energy beams of "elementary" particles as giant microscopes probing ever shorter distance scales within atoms, nuclei, and nucleons. Using a new approach unique to nuclear physics, RHIC is envisioned as a great pressure cooker to reveal the fundamental interactions of quarks--the recently discovered building blocks of nuclear particles--creating a basic and heretofore unobserved state of hot, dense nuclear matter. Using the capability of RHIC, scientists will be able to carry out fundamental experiments on the nature of matter which have not been possible in the past, and which cannot be carried out at any other existing or planned facility.

SUPERCONDUCTIVITY

Mr. Myers. Admiral Watkins informed the Subcommittee that the 6-7 GeV Advanced Photon Source (APS) under construction at Argonne National Laboratory (ANL) is critical for superconductivity and other materials research that the U.S. will need to remain competitive into the next century. He also indicated that the machine could be constructed on a faster and more efficient schedule. Please elaborate further on the nature of this project and what additional funding could be utilized in fiscal 1991 to accelerate completion.

Dr. Decker. The 6-7 GeV Advanced Photon Source is a facility designed to produce x-rays for research in materials, physics, chemistry, and biology. Many high technology areas including: semiconductors, superconductors, magnetic materials, catalysts, and medical applications would all be significantly impacted by this facility. Both the Europeans and the Japanese are building similar facilities. The Europeans plan to complete theirs one year ahead of ours and the Japanese at about the same time. We are reviewing the matter of an accelerated completion schedule right now.

Mr. Myers. What specific impact would an accelerated construction schedule for the APS have on the project's total estimated cost?

Dr. Decker. The proponent laboratory, ANL, has indicated there may be savings in the total estimated cost due to saving one year in escalation cost. ANL has proposed that any savings would be used to construct additional beam lines to improve the facility from the users' point of view. We are reviewing the entire situation.

Mr. Myers. What is the fiscal 1991 budget request for high temperature superconducting materials research and development in Basic Energy Sciences?

Dr. Decker. Included in the Basic Energy Sciences request for fiscal year 1991 are funds in the amount of $20.9 million for high temperature superconductivity. These funds are for basic research in the areas of materials properties, theory, synthesis, and processing.

Mr. Myers. How does this work compare to the efforts at the Department's Superconductivity Pilot Centers?

Dr. Decker. The efforts at the Department's Superconductivity Pilot Centers are directed to specific applications and technology transfer to industry. The Superconductivity Pilot Centers use the results obtained from the Basic Energy Sciences program to develop superconducting devices in partnership with U.S. industry.

Mr. Myers. Please update the Subcommittee on the status of the Midwest Superconductivity consortium.

Dr. Decker. We have a proposal from Purdue University for the Midwest Superconductivity Consortium, and we are in the final stages of negotiating a Cooperative Research Agreement for the purpose of supporting the Consortium.

UNIVERSITY AND SCIENCE EDUCATION

Mr. Myers. The fiscal 1990 Energy and Water Development Appropriations Act provided $1 million for upgrading and operating of university nuclear research and training reactors. How is the Department utilizing this funding and what is the fiscal 1991 budget for this activity?

Dr. Decker. In response to a program solicitation for support of university reactor instrumentation upgrades, proposals are currently undergoing merit review. We expect to make our selections by mid-April 1990, of those projects which can be supported within the $1 million available in the FY 1990 budget. No funds are included in the FY 1991 budget request to continue this effort due to competing priorities in educational areas.

Mr. Myers. The House Report accompanying the Energy and Water Development Appropriations Bill for fiscal 1990 directed the Department to complete a plan by March 1, 1990 for the utilization of all university-based research reactors and to inform the Committee of the feasibility of establishing a National Research Reactor Advisory Committee to advise DOE on related programs and support. Dr. Decker informed the Committee by letter of March 1, 1990, that the requested plan and recommendations are under preparation. When will this plan be completed and made available to the Committee?

Dr. Decker. We expect to send this response to the Committee in the very near future.

GLOBAL CLIMATE CHANGE

Mr. Myers. Please update the Subcommittee on the status of the National Institute on Global Environmental Change.

Dr. Decker. An informal proposal describing the management plan for the National Institute on Global Environmental Change (NIGEC) has been submitted to us by the University of California at Davis (UC-Davis). We have provided feedback to this proposal in order to ensure that the proposed NIGEC structure is acceptable to DOE. Assuming the formal proposal is received within the next few weeks we can expect to have a Cooperative Agreement in place by May 1990. We have also received a number of informal mini-proposals from some of the universities associated with NIGEC and my staff have responded regarding their relevance to the DOE research interests.

We expect that UC-Davis will serve as the National Center for NIGEC and that the four Regional Centers will be represented by Harvard University, Tulane University, Indiana University and the University of California at Davis. However, all U.S. universities will be able to submit proposals to one of the Regional Centers and to the National Center. We believe that the scientific proposals should be funded following a peer review process and DOE concurrence; a portion of the NIGEC work will support the DOE Office of Policy, Planning and Analysis. The Atmospheric and Climate Research Division of the Office of Health and Environmental Research will administer the Cooperative Agreement. Approximately $5.9 million will fund NIGEC activities in FY 1990; the FY 1991 projected funding is $6.0 million.

MAGNETIC FUSION ENERGY

Mr. Myers. Please update the Subcommittee on the Department's effort to revise policy for the fusion energy programs and how the Fusion Policy Advisory Committee (FPAC) will participate.

Dr. Decker. The names of the 19-member Fusion Policy Advisory Committee (FPAC) were announced by Admiral Watkins on March 5. The FPAC report will provide advice on how to structure the Department's magnetic and inertial confinement fusion programs in order to reach the goal of developing fusion as a viable technology. The recommended policy will include goals and objectives of the program, a strategy, an outline of the development path, identification of major decision points, determination of the role of international collaboration and recommendations on funding levels. The Committee is chaired by Dr. H. Guyford Stever, Foreign Secretary (Retired) of the National Academy of Engineering.

Mr. Myers. When will the new fusion policy be available to Congress?

Dr. Decker. The Committee will provide the Department of Energy with an interim report in July and a final report at the end of September. The final report will be shared with Congress at that time.

Mr. Myers. What are the current projections for the commercial power application of fusion?

Dr. Decker. Steady progress has been made in fusion towards this goal. While there are a number of factors that could affect the schedule for achieving this goal, I believe that with a new strategy, clear milestones and good management that fusion can be commercially available by 2025.

Mr. Myers. Please describe the fiscal 1991 budget request for the Confinement Physics Research Facility (CPRF) and its role in the Department's magnetic fusion program.

Dr. Decker. The fusion program is organized around four key technical issues. One of these is to determine the best confinement configuration for an economic, environmentally sound, and safe energy producing reactor. This is pursued by studying potentially improved devices or fuels. The devices include improvements in the tokamak, or other toroidal configurations such as the stellarator, or the reversed field pinch.

The purpose of the Confinement Physics Research Facility (CPRF) is to provide a magnetic fusion research facility that is capable of exploring, in a multikilovolt-temperature, collisionless plasma regime, the physics properties of a toroidal confinement concept that has the potential, in future devices, of ohmic heating to ignition with low magnetic fields. These physics properties include energy transport and magnetohydrodynamics (MHD) activity in high power density, low magnetic field configurations. The first device in the CPRF will be a reversed field pinch and physics studies will include tests of current drive for possible steady-state development in this configuration.

The CPRF is a construction project, with $11,100,000 requested in fiscal year 1991 funding. The first experimental device to be constructed in the CPRF is ZTH, a reversed field pinch configuration. It is scheduled for completion in August 1993.

Mr. Myers. Explain the fiscal 1991 budget request for the Compact Ignition Tokamak (CIT) and its role in the DOE magnetic fusion program. Why was construction of the CIT deferred in the fiscal 1991 budget request?

Dr. Decker. The role of CIT in the fusion program is to investigate the physics of self-heated, burning fusion plasmas. This is the most immediate of four key technical issues facing the fusion program and cannot be accomplished without a new experimental facility such as CIT. CIT will also generate substantial quantities of fusion power and thereby provide important information on the engineering of tokamak reactor systems.

The CIT project was originally proposed in the FY 88 budget for construction completion and operation in FY 1993. In 1989, Secretary Watkins requested that CIT construction funding be deferred due to concerns about the probability of ignition and the need to better understand the physics of plasma confinement. A reassessment of the CIT objectives, scope and ignition capability is now underway. Design and R&D in support of the CIT concept are planned to continue in FY 91 using approximately $16.8M in operating funds.

BIOMEDICAL RESEARCH

Mrs. Boggs. What is the status of funding for the Biomedical Research Institute at LSU Medical Center in Shreveport?

Dr. Decker. The Department is in the process of forwarding a request to the Congress to permit the government to vest title to the institution in the University, as has been done in the past with similar projects. Upon approval to do so, we will proceed to provide a grant award to the University. In the meantime, we are working with the University to ensure that the grant proposal and other necessary documentation is ready to be implemented at the earliest opportunity.

CEBAF

Mrs. Boggs. What is the status of the Continuous Electron Beam Accelerator Facility (CEBAF)? What remains to be done before this project becomes operational?

Dr. Decker. Project completion remains on schedule for FY 1993, and our FY 1991 request of $65 million for construction is the planned level in the funding profile. The accelerator tunnel construction is now 80 percent complete and scheduled for occupancy next fall. The office and meeting room complex known as the CEBAF Center was dedicated and occupied last October. The central helium refrigerator building is complete and the refrigerator is scheduled to be commissioned in November 1990. The renovated Space Radiation Effects Laboratory building, Test Laboratory, is in heavy use for testing technical components and the accelerator control center building is complete. A prototype accelerator cryomodule was completed and tested last year, and cavity procurement is now underway. The experimental area plans passed a radiation safety review last fall and a subcontract for their construction has been awarded. The major uncompleted activity is the acquisition and installation of the accelerator components. A plan for equipping the experimental areas is nearing completion and will be reviewed by DOE and the Nuclear Science Advisory Committee.

HIGH TEMPERATURE SUPERCONDUCTIVITY

Mrs. Boggs. Recently, I saw a newspaper article that reported concerns in the scientific community that adequate resources are not being devoted to small scale research on superconductivity. Please discuss the level and mix of the Department's funding of this type of research.

Dr. Decker. The Department has strived very hard to use a mix of laboratory and university personnel in order to take advantage of the expertise that each has to offer in high temperature superconductivity. In the area of theory as an example, we find that the talents in the university community are an excellent source. The laboratory expertise is best suited to applying a multidisciplinary approach and where the unique capability of a research facility are required. Therefore we feel both institutions have a unique contribution to make and we feel the mix of funds is appropriate given the level of funds requested for FY 1991.

GEOSCIENCES

Mrs. Boggs. Please describe the Department's geosciences research program.

Dr. Decker. The Department's central fundamental research activities in the geosciences are carried out as part of the Basic Energy Sciences program. The primary focus of these activities is on the geophysics and geochemistry of rock/fluid systems, including emphasis on high resolution underground imaging. Other topics emphasized in the program include geochemical migration, basic geosciences studies of sedimentary formations where oil and gas are located, continental scientific drilling and isotopic studies. This research is expected to pay off in improved approaches to the recovery of oil and natural gas, solutions to problems in the isolation of hazardous wastes and environmental restorations, and advances in our knowledge of, and access to, the full range of the earth's energy resources.

Shorter-term or more specifically targeted research in the geosciences forms a significant part of a variety of other DOE programs. For example, the Biological and Environmental Research program includes a substantial effort concerned with terrestrial transport of energy-related pollutants involving many geohydrologists and other geoscientists. The programs under the Assistant Secretary for Fossil Energy include a variety of studies related to oil, gas and coal resources. These studies are coordinated with all parts of the Department through an Office of Geosciences Research. The programs under the Assistant Secretary, Conservation and Renewable Energy include studies of geothermal technologies involving many geoscientists. As these examples illustrate, a broad range of DOE's activities draw upon the special knowledge and skills of the geoscientists, reflecting the fact that energy resources

come from the earth and the sun, and wastes from their use are returned to the earth's crust and atmosphere. Coordination of the research is maintained through several committees which focus on particular areas. For example, the Hydrocarbon Geoscience Research Coordinating Committee organized by Fossil Energy's Office of Geosciences Research, includes representatives not only from each of the relevant parts of DOE but also from the National Science Foundation and the United States Geological Survey. Continental scientific drilling activities are coordinated by an Interagency Coordinating Group and by a separate DOE coordinating committee.

FUSION POLICY ADVISORY COMMITTEE

Mrs. Boggs. Would you summarize the mission of the Fusion Policy Advisory Committee.

Dr. Decker. The Fusion Policy Advisory Committee (FPAC) was established under the provisions of the Federal Advisory Committee Act (P.L.92-463) to review, on a one-time basis, both magnetic and inertial confinement and provide its recommendation for a fusion policy to the Department of Energy. This committee will provide advice on the best way to reach the goal of developing fusion as a viable technology. The recommended policy will include goals and objectives of the programs, a strategy, an outline of the development path, identification of major decision points, determination of the role of international collaboration, and recommendations on funding levels. Admiral Watkins announced the names of the 19 members of FPAC on March 5. The Committee, which is chaired by H. Guyford Stever, will hold its first public meetings on March 22 and 23.

Mrs. Boggs. You indicate budget estimates will be revised based on its review. Should we expect significant or moderate changes?

Dr. Decker. It is difficult for me to anticipate what the recommendation of the Fusion Policy Advisory Committee will be. I assure you that I will follow FPAC deliberation with great interest and keep this Committee fully informed of developments.

Mrs. Boggs. Is the research currently funded or budgeted of value to the fusion program irregardless of any redirection in the program the Committee might make?

Dr. Decker. The FY 1991 budget provides for a continuation of the program that is underway in FY 1990 with an emphasis on increasing our understanding of confinement. The FY 1991 budget was drafted with the understanding that a high level fusion policy review would be completed by the end of September 1990. With this policy review time schedule in mind, the FY 1991 budget is structured, as much as possible, to maintain options, continue scientific progress and international cooperation and avoid damage to the U.S. fusion research infrastructure until recommendations from this review can be implemented.

POSITRON EMISSION TOMOGRAPHY

Mr. Pursell. What support has the Department of Energy provided in the development of Positron Emission Tomography (PET)?

Dr. Decker. Since the 1950's, the Biological and Environmental Research Program has been giving steady and systematic funding support not only to the national laboratories, but also to universities to improve the state-of-the-art of PET technology.

Funding profiles for the program in Fiscal Years 1989, 1990, and 1991, are $10.2 million, $10.1 million, and $10.7 million, respectively.

Mr. Pursell. What are the Department's objectives with PET? What does the Department hope to accomplish?

Dr. Decker. The Department's objective with PET is to support research which will provide new radiopharmaceuticals and improve instrumentation and methodologies for use in the studies of regional chemistry and metabolism. The Department will continue to foster the transfer of PET technology to users and industry.

Mr. Pursell. Could you please discuss the Department's role in technology transfer in the medical field?

Dr. Decker. In order to provide improved opportunities for adoption and use of Federally-funded technology research and development (such as, PET technology), and in response to the Stevenson-Wydler Technology Act (P.L. 96-480), DOE established the R&D Laboratory Technology Transfer Program, managed by the Office of Energy Research. Since its implementation, DOE has successfully fostered person-to-person interactions between laboratory scientific personnel and technology recipients. The Department's laboratories are actively helping to transfer the PET technology to users and industry.

Mr. Pursell. Where are PET-scan machines presently being used and where else do you think the Department could focus its efforts to further develop the PET scan technology?

Dr. Decker. Currently, the majority of PET centers world-wide are involved in basic research, but use of the PET-scan machines for clinical applications is increasing. The Department could continue its role in supporting research and development of PET technology to develop simpler, easier-to-operate accelerators, new PET radiopharmaceuticals, techniques for labeling molecules automatically, such as, robotics, and radioisotope generators for medical centers without access to a cyclotron.

GENERAL SCIENCE AND BASIC ENERGY SCIENCES

Mr. Pursell. How does the Department view its role in the areas of General Science and Basic Energy Sciences, with regard to American competitiveness and the ability to compete in tomorrow's world economy?

Dr. Decker. The Department views its role in General Science and Basic Energy Sciences as providing a fundamental foundation of efforts necessary to enhance the future economic competitiveness of the U.S. Understanding gained through research programs in these areas is essential to making further advances leading to technology application and commercialization. Scientific results from the programs are widely applied in technology development efforts both in the Department's applied research programs and outside DOE. Scientific user facilities supported by the program are utilized by a wide array of university and U.S. industrial scientists, resulting in both new scientific discoveries and new technology applications. As part of the National Energy Strategy, the Department is currently exploring new methods to exploit near-term commercial opportunities arising from both basic and applied research programs in a more systematic way.

Mr. Pursell. The number of proposals received by the Division of Energy Biosciences has grown dramatically in recent years, doubling in the past three years. While the requested level of funding for the Division of Energy Biosciences has increased somewhat, the percentage of proposals funded has decreased significantly -- from about 17 percent in FY 1987, to an estimated 4 percent in FY 1990. Do you support the research efforts within this Division, and do you believe the Administration's proposed level of funding is sufficient?

Dr. Decker. The DOE is convinced of the need to support the scope of basic biological research that the Energy Biosciences program represents. The level of funding requested for the Division of Energy Biosciences represents a defensible level considering the myriad missions, responsibilities and priorities falling within the Office of Basic Energy Sciences and the Office of Energy Research, and the resources available to these organizations.

Mr. Pursell. Do you believe that the American biotechnology industry can remain internationally competitive within the proposed funding levels?

Dr. Decker. The Division of Energy Biosciences supports basic research that provides the fundamental information critical for the development of future biotechnologies based on plants and non-medical microorganisms. The Energy Biosciences program has, and will continue to provide as much as possible of the essential fundamental knowledge essential for the American biotechnology industries to be competitive in the international marketplace within the confines of the resources available to the Department of Energy.

Mr. Pursell. How do you think biotechnology can help us solve our nation's energy needs?

Dr. Decker. The discovery and description of the fundamental biological processes and their related mechanisms can be employed as the basis of future biotechnologies having major impacts on the energy resources of this country. Clearly, studies on green plants as producers of renewable resources represent a major potential target for biotechnological development. Biomass productivity encompasses a broad array of processes that are integrated to form the complex entity, a terrestrial or aquatic plant. The ability of biotechnologies to address these component processes and their regulation, provided that adequate fundamental knowledge exists, will have profound effects on the production of renewable energy supplies. Our fundamental knowledge of that portion of the microbiological world involved with biochemical transformations that yield potential fuels and chemicals is increasing. Biotechnological manipulation of these organisms to optimize biotransformation processes should become the basis of new industries. These bioconversion processes can provide a substitute for fossil energy resources directly or through energy conserving measures in which biological mechanisms displace industrial energy inputs.

Mr. Pursell. How do you think biotechnology can help us address our environmental needs?

Dr. Decker. Biotechnological manipulation of various biological processes will likely have major impacts on the environmental health of this country. These impacts range from the cleanup of contaminated sites, to the detoxification of industrial process streams, to beneficially effecting global warming. Molecular biology has the capacity to address the physiology, biochemistry, genetics and regulatory biology of non-medical microbes involved in many bioremediation processes. Processes ranging from the metabolism of inorganic nitrates and sulfates to the depolymerization and mineralization of heterocyclic and aromatic polymers to the conversion of simple organics to carbon dioxide or methane. Molecular genetic manipulation of plant systems may also lead to their exploitation for the bioremediation of surface soils and the potential to supply novel enzymatic capabilities for the development of new pathways for the degradation of toxic chemicals. The flux of carbon dioxide and other gases in the environment is to a large degree determined by biological processes such as photosynthesis and methanogenesis. The seasonal oscillation observed in CO_2 concentrations is a good illustration of the magnitude of the photosynthetic process on a global scale. Fundamental research conducted on photosynthesis should elucidate the processes amenable to change as well as providing insights into just how heavy is the biological contribution to the flux of gases in the global climate equation. Although the exact biogenic contribution of methane to the global pool is still uncertain, it is clear that methane deriving from biological systems is a major contribution. Biotechnological modification of the biological

methanogenesis process, carried out by anaerobic microorganisms, may provide strategies for influencing the load released to the environment.

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88 INCH CYCLOTRON

Mr. Fazio. As you know, the Committee has a longstanding concern that as newer more capable user facilities come on line, older facilities will have to be shut down. Could you tell the Committee what the Department is planning to do in the Nuclear Physics program when both CEBAF and the proposed RHIC are completed?

Dr. Decker. The newest understanding of the nuclear force is based on the QCD (Quantum Chromodynamics) theory which incorporates the knowledge that nucleons have a substructure composed of quarks. The heretofore more empirical studies of nuclear structures and interactions can now be refocused into this more deeply fundamental approach. This refocussing requires new appropriate facilities, such as CEBAF and RHIC, for this more fundamental approach to the problem of nuclear physics. The scientists themselves, by their programs and in their advisory bodies, are leading into the new directions. At CEBAF, almost 300 scientists have already submitted proposals for experiments that would begin in 1994, and a similar number are presently involved in the ongoing relativistic heavy ion program, about one half of them from the United States. This community is already actively involved in planning for the RHIC experimental program.

As scientists transfer their experimental program to the emerging forefront areas of science, we will carefully monitor the activity of the ongoing facilities. As this process naturally develops, we will phase out those facilities whose level of activity has become marginal and whose programs are no longer of highest scientific priority.

Mr. Fazio. I noticed in the Heavy Ion Nuclear Physics program that the Department is planning to close one of three smaller nuclear physics facilities at the National Laboratories. Could you describe for the Committee the process by which the Department will decide which of the three facilities to close?

Dr. Decker. The Nuclear Science Advisory Committee has recently completed an intense year long set of activities leading to a new long range plan for nuclear science (Nuclei, Nucleons, Quarks-Nuclear Science in the 1990's, December 1989). In implementing the specific activities that will be required to conform with the scientific priorities set by that plan, we will continue to consult with NSAC. Specifically, in the phaseout of research activity at a smaller heavy ion facility at a National Laboratory, NSAC will be asked to advise us on how to proceed with the minimum scientific impact.

Mr. Fazio. Isn't it true that the 88 Inch Cyclotron at the Lawrence Berkeley Laboratory is closely coupled to the eduction programs at the University of California, Berkeley? In this regard, isn't it true that the 88 Inch Cyclotron is more appropriately compared to the facilities at Yale, Michigan State and the University of Washington?

Dr. Decker. The 88-inch cyclotron, jointly with the chemistry department of the University of California, Berkeley, does conduct a strong program in radiation chemistry which is supported by the Basic Energy Sciences program within the DOE. It also hosts a similar number of graduate students associated with outside user professors located at institutions throughout the country, and indeed throughout the world. The DOE takes its educational responsibilities seriously and supports a comparable number of visiting scientists and their students at all its low energy facilities. In this regard the National Laboratory programs are different from those at the dedicated University facilities, which are designed to support the faculty and students at those specific institutions.

Mr. Fazio. It appears from the budget document that it costs approximately $2 to $3 million per year to operate each of these machines. If one of these machines is closed, will it make much of an impact on the program's budget? How much are the projected annual operating budgets for both CEBAF and RHIC?

Dr. Decker. Depending on the selected facility, phasing out of operations at one of these facilities would result in a savings of about $3 to $4 million in operating costs, which is about 10 percent of the amount allocated for operations of heavy ion facilities. There would also be a smaller savings in the area of Capital Equipment and AIP projects. The allocation of any funds must undergo continual review to ensure that they are spent in conformance with the highest scientific priorities of the program. As described in the Congressional Construction Project Data Sheets, the projected annual operating cost for CEBAF is $37.8 million in FY 1991 dollars, and for RHIC is $60.9 million, also in FY 1991 dollars.

Mr. Fazio. Considering the low cost of operating these three facilities, might it make more sense to keep all three operating?

Dr. Decker. A review of the low energy heavy ion facilities conducted by the DOE in 1987 recognized the changing patterns of scientific research in shifting to higher energy facilities, especially in the area of nuclear reactions. In addition, based on NSAC recommendations, additional resources in the heavy ion area were obtained with the successful completion of facility upgrades at Texas A&M, the University of Washington, and Yale University. Similar upgraded facilities have been provided in the NSF program. These university facilities are ideally suited for the scientific scope and experimental methods for conducting low energy heavy ion research. Thus, we are faced with additional facility capability in an area of still strong, but declining scientific interest. Scientific priorities determine that the DOE Nuclear Physics program must devote an increasing fraction of its resources to the newly emerging physics frontiers.

HUMAN GENOME LABORATORY

Mr. Fazio. The proposed FY 1991 budget contains a large increase for the Human Genome Project, which I strongly support, but once again there is no request for new laboratory space to house this rapidly growing project. Could you tell the Committee, Dr. Decker, whether the Department had any requests for laboratory construction from its national laboratories?

Dr. Decker. The Lawrence Berkeley Laboratory requested construction money for a new Human Genome Center building to begin in FY 1991.

Mr. Fazio. Did any of those requests make it into the DOE budget submission to OMB?

Dr. Decker. The Department included a request for $2.8 million to begin construction of the Lawrence Berkeley Laboratory building in FY 1991.

Mr. Fazio. What did OMB do with these requests for new laboratory construction?

Dr. Decker. The OMB allowance for the Department's FY 1991 request to Congress did not include funds for the Lawrence Berkeley Laboratory building.

Mr. Fazio. How does the Department of Energy expect to play a major role in the Human Genome Project if it dramatically increases its operating budget but is unable or unwilling to provide the laboratory space necessary to do the job?

Dr. Decker. The Department's Human Genome Centers at the Los Alamos and Lawrence Berkeley Laboratories are actively engaged in genome research and development and are beginning to hire additional staff. Adequate space is available to permit these nationally important centers to function over the short term. It is foreseeable that more space will be needed in the outyears and the Department, in conjunction with the involved Laboratories, is exploring possible solutions to the space problem.

Mr. Fazio. As you know, the Department of Energy has for over forty years supported research into the use of proton beams to treat and cure cancer. Proton therapy has been called "the quintessential example of technology transfer from high energy physics research to the service of man and his needs."

This year, Loma Linda University Medical Center will open the first patient care facility in the world that will offer proton therapy to treat cancer. Research will be needed to further develop the technology and develop new applications for its use.

Does the Department of Energy plan to support training of doctors and technicians treating patients in proton therapy?

Dr. Decker. The Department of Energy proton therapy program at Lawrence Berkeley Laboratory does not have a specific funded program to train doctors; however, the program does support graduate students, post-doctorals, persons on sabbatical, and foreign scientists. The doctors and technicians at Loma Linda University Medical Center were trained through collaboration with the Lawrence Berkeley Laboratory and Massachusetts General Hospital.

Mr. Fazio. Does the Department foresee a demonstration program to build other proton therapy facilities, so that proton therapy is available to cancer patients across the country?

Dr. Decker. The Harvard Cyclotron Laboratory in conjunction with Massachusetts General Hospital has been operational since 1965 with funding support through medical insurance payments. The Department does not foresee a demonstration program to build other proton therapy facilities. However, the NCI recently has issued a request for proposals to solicit proposals to plan and develop proton therapy facilities.

Mr. Fazio. I understand that the National Cancer Institute recently issued a request for proposals to solicit proposals to plan and develop proton therapy and research facilities. NCI has $1.5 million set aside in FY 1990 for this purpose. Please explain how DOE is interfacing its activities in this area with those of NCI.

Dr. Decker. DOE staff interacts with the NCI Radiotherapy Development Branch to exchange information on programmatic issues of common interest. Staff members of each agency attend scientific reviews of research projects of each agency to maintain an awareness of the research activities in proton therapy.

Mr. Fazio. What are the advantages and disadvantages of a heavy ion therapy over proton beam therapy?

Dr. Decker. A heavy ion beam can provide sharper dose delivery, that is, it can deliver the radiation dose more precisely to the tumor because the heavy ions scatter much less than protons. The current experimental heavy ion clinical trials at the Bevalac are developing information to evaluate this potential advantage over proton therapy more completely. Accelerators for heavy ion therapy would be more costly to construct and operate than proton facilities.

Mr. Fazio. Does the Department foresee a demonstration program involving the heavy ion technology in a manner similar to the proton beam technology?

Dr. Decker. The Department is currently supporting research at the Lawrence Berkeley Laboratory to develop stereotactic radiosurgery, that is, precise deposition of dose to a three-dimensional space, using high energy particle peaks from helium, carbon and neon ion beams at the Bevalac. Applications include treatment of intracranial arteriovenous malformations and brain tumors in man, and the study of physiologic responses of vascular lesions to radiation-induced damage in order to optimize parameters of charged particle radiation dose delivery. In addition, a cooperative effort with the NCI is evaluating the clinical feasibility of heavy ion radiation therapy for a variety of tumors.

FUSION ENERGY

Mr. Fazio: In a recent Washington Post article, Secretary Watkins was quoted as believing that problems with the disposal of radioactive wastes from fission reactors will be replaced in the relatively near future by fusion production of energy. Would you please elaborate on your current thinking about the state of fusion energy production?

Dr. Decker: The engineering feasibility of using fusion as an energy source for the production of electrical power has yet to be demonstrated. The most advanced fusion research devices in the world (Tokamak Fusion Test Reactor, Joint European Torus) are capable of generating kilowatt levels of fusion heat energy in deuterium plasmas for only a few seconds. These present day devices could produce megawatt levels of fusion heat energy if they were fueled with tritium and deuterium. The ability to generate hundreds of megawatts of fusion heat energy could be demonstrated in next-step fusion devices. CIT would generate such energy levels for seconds, while an ITER-like fusion engineering test reactor could do so for minutes or hours. While a fusion engineering test reactor would not produce electricity, it would develop the physics and technology base needed for a fusion electric power demonstration facility in the first half of the next century.

Mr. Fazio: Which fusion technologies do you view as most promising?

Dr. Decker: The two approaches that now appear promising for fusion energy are based on the "magnetic" and "inertial" confinement concepts. Other concepts, such as "cold fusion" are considered by the DOE's Energy Research Advisory Board to be much less promising. The recently formed Fusion Power Advisory Committee will review both the inertial and magnetic fusion research programs and provide recommendations on strategies for development of these options.

Mr. Fazio: On what time scale do you expect fusion power to become commercially viable?

Dr. Decker: The time scale for developing fusion power to the stage of commercial deployment depends heavily on the budgets provided for research and development. Demonstration of engineering feasibility can technically be achieved within the next 20-30 years. If an engineering text reactor was successful in its mission, construction of a fusion power demonstration facility could begin shortly after this. Commercialization of fusion power could potentially begin by 2025.

Mr. Fazio. In its overview of the Magnetic Fusion program, DOE noted correctly that great progress has been made in this program. Over the past 20 years, Tokamak performance has increased by more than 7 orders of magnitude, as measured by the ratio of fusion energy produced to heat lost from the plasma. In very recent results from the Tokamak Fusion Test Reactor, the Doublet III-D Reactor and the Joint European Tokamak, the state of the art is very close to the breakeven point of producing as much fusion energy as heat lost from the plasma. The higher goal of producing ignition in which the heat produced by fusion continues the fusion reaction now appears to be technologically within sight.

However, despite the great technological progress in this program, DOE's FY 91 request is less, in current dollars, than the FY 90 budget level and significantly less than the FY 89 level. Why, despite the great technological progress, is the FY 1991 budget request so low?

Dr. Decker. You are correct, the Magnetic Fusion Energy program has made great technological progress. However, I feel that the President's FY 1991 budget is appropriate to maintain options, continue scientific progress and international cooperation and avoid damage to the U.S. fusion research infrastructure for the duration of the Fusion Policy Advisory Committee review. When this review is completed, it may be necessary to make budget revisions that reflect changes in the Department's fusion energy policy.

Mr. Fazio. The Compact Ignition Tokamak (CIT) is the next generation of tokamak which is designed to produce the first ignition and thus is critical to the development of a commercial fusion reactor. The FY 1991 budget request for CIT is, however, below that of FY 1990. Why?

Dr. Decker. The FY 1991 budget request provides for a continuation of the FY 1990 effort pending completion of the Fusion Policy Advisory Committee review. The FY 1991 budget request of $16.8 million provides for continuation of preliminary design to improve device performance and conduct technology R&D in support of prototype fabrication.

Mr. Fazio. I understand that tritium is a necessary fuel for a viable fusion reactor and that the TFTR at Princeton is the only fusion device in the U.S. equipped to use tritium. However, the use of tritium in the TFTR reactor has been repeatedly postponed by DOE. When will this machine get the go ahead for tritium?

Dr. Decker. Assuming that the funding for this activity is provided, Deuterium-Tritium operation could commence in FY 94. This option is being maintained until the Fusion Policy Advisory Committee review is completed.

Mr. Fazio. What are other countries planning to do about the use of tritium?

Dr. Decker. The only other magnetic confinement fusion experiment in the world capable of tritium operation is the Joint European Tokamak (JET) in Culham, England. Our understanding is that in order to carry out their present program of investigations on JET, they are unlikely to proceed with tritium operation until the 1995-96 timeframe.

Mr. Fazio. Japan and the European Community are each outspending the U.S. on fusion research and they are beginning to surpass us in terms of accomplishments. Is my understanding correct? If so, do Japan and Europe know something we do not? Why are they outspending us in development of fusion energy?

Dr. Decker. Comparative expenditures among the major fusion program countries are at best approximations because of the differences in funding and employment arrangements. Our most current estimates indicate that we and the Japanese spend about the same amount of money, i.e., about one-fifth of the world's total, while the European Community spends about one-third of the total. The Soviet Union also spends about one-fifth of the total with the smaller programs accounting for the remaining expenditures.

Both the European Community and Japan have continued to make new capital investments in fusion research and as a result they will surpass us in terms of new facility capability.

While we cannot presume to state the reasons for their fusion investments, it does appear that in both the European and Japanese programs, expenditures thus far have been characterized by maintenance and re-confirmations of long-standing policy directions, rather than reflecting any new change in policy.

Mr. Fazio. Fusion reactors represent a potential national expenditure of hundreds of billions of dollars in the next century. What is the DOE doing to ensure that the U.S. retains the lead in fusion research so our industry can take advantage of this technology instead of buying it from foreign sources?

Dr. Decker. With the continuous reduction in funding for magnetic fusion energy R&D over the past decade, it is not possible for the U.S. to retain the lead in fusion research in the face of sustained and greater funding for fusion abroad. In this circumstance, the U.S. program has negotiated many international agreements in order to maintain the comprehensiveness of our activities. In each of these agreements, we have given serious attention to the fair treatment of intellectual property rights and to ensuring equal access to the work for industries from all Parties to the agreements.

STANFORD SYNCHROTRON RADIATION LABORATORY (SSRL)

Mr. Fazio. In response to extremely high demands for beam time from a wide variety of federal, academic, and industry users, new beam lines are being commissioned at SSRL and the amount of user time available is being very substantially increased. Is the proposed operating budget of $13.981 million adequate to operate SSRL in light of the expanded user schedule?

Dr. Decker. Yes. It will provide for 30 weeks of operation which is comparable with operating times for other major Office of Energy Research user facilities.

NATIONAL INSTITUTE ON GLOBAL ENVIRONMENTAL CHANGE

Mr. Fazio. It is my understanding that the regional universities involved in the Institute expect to finalize a management plan in the next week or two, finalize the Cooperative Agreement with DOE in early April, and initiate its research projects -- which DOE has reviewed -- shortly thereafter. Is the Department pleased with the progress that is being made in setting up the Institute and the research that the Institute intends to launch on behalf of the Department during fiscal 1990?

Dr. Decker. There has been considerable discussion between representatives of the proposed Institute and with members of my staff. The discussion has covered the management structure for the Institute as well as the scope of the proposed research. We expect to receive an acceptable formal proposal to set up the Institute from the University of California at Davis within the next few weeks and a Cooperative Agreement may be in place by May 1990. We believe that all U.S. universities will have the opportunity to submit proposals to the Institute or to one of its four Regional Centers and that the selection process will include a scientific peer review.

SUPERCONDUCTING SUPER COLLIDER

Mr. Fazio. On Monday, Secretary Watkins skirted the issue of international participation in the SSC fairly carefully. The Committee understands that foreign participation will be in excess of $800 million. But it remains unclear which countries will contribute to the SSC. What is the status of foreign commitments of funds or in-kind contributions to the project?

Dr. Decker. At this time, only India has provided a written statement giving us a tentative commitment to provide up to $50 million in manpower and hardware over ten years. Because of current uncertainty on the cost of the SSC, we have been reluctant to pursue international contributions. For effective international collaboration, we need to have a reliable cost estimate for the SSC. We cannot expect foreign countries to make commitments until we can be more certain on the scope, cost and schedule of the project. By early summer, we expect to have a firm cost estimate and, therefore, plan to approach countries officially about their interest in contributing to and participating in the SSC program.

Mr. Fazio. Last year, Dr. Hunter noted that India had signed a tentative agreement with the Department to contribute $50 million toward the SSC. Dr. Hunter also indicated that a number of countries, including Japan, South Korea, Switzerland, Finland and Spain, had expressed interest in participating in the project but that firm commitments would not be likely until construction funds are appropriated. Now, that construction funds have been appropriated have any other countries come forward with commitments of support for the project?

Dr. Decker. No, we have not proceeded with any formal contacts because of the hold pending our review of the scope and cost of the project. Other countries that have expressed an interest include Italy, Canada, and the Soviet Union. In addition, at the scientific level there is great interest in the SSC program around the world. For example, roughly 20% of the attendees at the February 1990 Workshop on SSC Detectors under the sponsorship of the University of Arizona were from abroad, and about 150 foreign scientists, or 20% of the total, participated in the first international conference on SSC physics, hosted by the SSC Laboratory last October.

Mr. Fazio. What countries have expressed an interest in participating in the SSC, and have they expressed an interest in contributing with cash, in-kind services or both?

Dr. Decker. All countries with a capability in high energy physics have expressed an interest in the SSC program. This includes almost all of the countries that are members of the Organization for Economic Cooperation and Development, the Soviet Union, and the Peoples Republic of China. We have not had any formal contacts with them concerning their interest in donating cash, in-kind contributions, and services.

Mr. Fazio. What steps has the Department taken since January of last year to attract international participation in the SSC?

Dr. Decker. The Department has used 1989 to prepare itself for international negotiations. In 1989 the Department prepared an International Plan and moved forward on a scope, cost estimate, and schedule for the SSC. The Department drafted an International Plan which was subsequently approved by an interagency review group. The Plan provides the framework within which the DOE will conduct negotiations.

DIVISION OF ENERGY BIOSCIENCES

Mr. Thomas. I am aware of the critical research being funded by the Division of Energy Biosciences to help lay the groundwork for the use of biotechnology to address growing public concerns regarding hazardous waste clean-up, global warming, the development of alternative energy resources and other important issues. I strongly support the work of the Division of Energy Biosciences in these areas. What is the Department's funding request for FY 1991 for the Division of Energy Biosciences?

Dr. Decker. The Department's funding request for the Energy Biosciences program is $20.2 million dollars.

Mr. Thomas. Is this a decrease from current funding levels?

Dr. Decker. This is a decrease of $474,000 from the FY 1990 funding level.

Mr. Thomas. What percentage of grant proposals are being funded?

Dr. Decker. In FY 1990 the number of new proposal requests received by the Energy Biosciences program increased sharply. That, in combination with an essentially static budget, has resulted in a low percentage of funding of new proposals which in FY 1990 is estimated to be about 4%.

Mr. Thomas. Are high quality competitive grant proposals going unfunded because of lack of funding in this program?

Dr. Decker. Indeed, there are many meritorious, high quality proposals for which there are no monies available for funding. However, this situation is not confined to the Energy Biosciences program but can be found throughout the research programs within the Office of Energy Research.

Mr. Thomas. Dr. Decker, I believe many of the competitive research projects funded by the Division of Energy Biosciences are very innovative, "cutting edge" projects, which will provide major breakthroughs in biotechnology in the future. Yet, I am concerned that the diminishing resources and low percentage of grant submissions awarded in this program will discourage bright young researchers in the field. In your estimation, what level of increase in funding for the Division of Energy Biosciences could be effectively utilized to expand awards for high quality competitive proposals?

Dr. Decker. The Energy Biosciences program, since its inception in FY 1980 at a level of $6.0 million, has been incremented progressively until FY 1988 to a level of about $20 million. This gradual growth has permitted the program to be built soundly in a strongly competitive mode where high quality science and program interest were key criteria. Regrettably, since FY 1988, the program has been held at a near constant level because of extraordinary pressures on the Basic Energy Sciences budget. This has resulted in a declining success rate for proposals submitted to the Energy Biosciences program, and, in addition, in order to make the funds go farther, the awards have been at a restricted level rather than at an optimal level. It also must be said that these pressures have similarly impacted other of the programs of the Office of Basic Energy Sciences. In response to your question about a level of increase in the Energy Biosciences budget that could be effectively utilized to expand awards for high quality research, I would have to say that given the pressures of deficit reductions the Government faces, I believe that this program has not been singled out for funding reductions and is funded at an appropriate level. No program exists in isolation and the Energy

Biosciences program is no exception. The perceived needs of this program must be modulated by competing needs with the Basic Energy Sciences program and other research programs in the Department.

Mr. Thomas. I understand that the DOE budget has a large increase in funding for clean-up of nuclear and hazardous waste sites. Are a portion of these clean-up funds allocated for research to develop new biotechnologies for such clean-ups? If so, will these research funds be available for proposals submitted to the Division of Energy Biosciences? If not, will basic research proposals applicable to clean-up be funded by an office other than the Division of Energy Biosciences.

Dr. Decker. To support the 30-year cleanup goal established in the Secretary of Energy's Environmental Restoration and Waste Management Five Year Plan, and to reduce the cost of that cleanup, a vigorous applied research and development program has been put in place and supported with significant funding in the Environmental Restoration and Waste Management program. This program will focus on applied research, demonstration and testing of new technologies to resolve existing technical issues in environmental restoration and waste management and to advance rapidly beyond currently available technical approaches. Biotechnologies will be evaluated within this program for their potential as innovative and cost-effective cleanup technologies. Basic research proposals directed toward environmental cleanup will continue to be evaluated and supported by the Division of Energy Biosciences, within the Office of Energy Research. Proposals for applied research or demonstration will be evaluated and supported by the new Environmental Restoration and Waste Management program, managed under the Office of Environmental Restoration and Waste Management. A basic/applied research working group has been set up to provide coordination between the basic and applied research programs. This working group will identify basic research needed to support applied research and ongoing basic research that has potential for transition to the applied phase.

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SUPERCONDUCTING SUPER COLLIDER

Mr. Chapman. Please describe briefly the findings of the High Energy Physics Advisory Panel (HEPAP) regarding the updated design of the Superconducting Super Collider?

Dr. Decker. HEPAP unanimously endorsed the report of its blue ribbon subpanel and further stated that, "Timely completion of the SSC remains the highest priority of the national High Energy Physics program." The subpanel concluded that, "The SSC Laboratory, in its current proposal, has chosen wisely among the alternatives and that the project should move forward expeditiously." They concluded that the only way to keep the cost of the SSC at $5.9 billion would be to seriously reduce its capabilities. The subpanel felt strongly about the need for a flexible and reliable facility at 20 TeV for decades to come and that it would be very unwise to redesign the machine with a reduced circumference. HEPAP, in turn, endorsed the energy and physics research goals of the SSC as currently proposed.

Mr. Chapman. What technical challenges have to be resolved in the updated design?

Dr. Decker. The updated design introduces no major new technical challenges other than the new superconducting collider dipole magnet with larger aperture. Even in this case, much of the work to date on the 4 centimeter magnet will be adaptable. Of course, in a project of this complexity and magnitude, there are many technical challenges and many of these remain to be addressed in detail as we proceed from the conceptual design phase to the final design and fabrication phase. The design is based, however, on the experience from previous accelerators using similar techniques and components, so we do not anticipate any fundamental problems.

Mr. Chapman. What are the technical challenges in the SSC magnet program?

Dr. Decker. The first challenge is to use our experience with the 4 centimeter magnets to design and test the new 5 centimeter magnet. Other key technical challenges in the SSC magnet program are manufacturability and reliability. It is for this reason that great emphasis is being placed at DOE and the SSC Laboratory on the Magnet Industrialization program.

Mr. Chapman. What has been the success rate of superconducting magnets that have been tested to date?

Dr. Decker. About two years ago, a key insight into the mechanics of superconducting accelerator magnets led to a major change in design: firm clamping of the collared coil using the iron yoke. Since that time, all but one of the seven long magnets built were successful, achieving full operating field of 6.6 Tesla on the first or second attempt. The remaining magnet had a quality control error--the leader from the cable spool was wound into the magnet instead of being discarded.

Mr. Chapman. Please describe the status of the plan for international participation in the SSC project.

Dr. Decker. The International Plan has been reviewed by an interagency group and it is now being finalized. Because of the sensitive negotiating material contained in the document, the document has been classified. We intend to brief Congress in the near future on the International Plan.

Mr. Chapman. When do you anticipate firm commitments from foreign countries?

Dr. Decker. We hope to secure indications of firm commitments within the year but it may take longer. While interest is very high in the SSC program, countries will not make commitments until they are confident of the future of the program, and they have had time to study the SSC program, see how it fits into their own national priorities, and adjust their own resource budgets accordingly.

Mr. Chapman. What form will such participation take?

Dr. Decker. We anticipate that countries will make in-kind contributions to the construction of the SSC and, in some cases, will be willing to donate manpower as well. We have not ruled out the possibility of cash contributions. Based upon the early preparations for the various experimental programs and detectors for the SSC, we also expect considerable in-kind contributions to the detectors from abroad.

Mr. Chapman. Is the $318 million requested by the Department for the SSC in FY 91 enough to keep the project moving forward in a timely fashion?

Dr. Decker. Yes, we believe the $318 million request will permit the project to move forward at an appropriate pace. The request includes $139 million for research and development where there will be significant efforts to complete the design of the new 5 centimeter superconducting magnet, extensive research and development on injectors and other technical systems, and a major detector research and development effort. The $169 million of construction funds requested would be used primarily for detailed design of technical systems and conventional facilities, the magnet industrialization program, and establishment of the laboratory teams to manage and carry out the SSC project.

Mr. Chapman. Please describe the major milestones in the SSC project that have been achieved recently.

Dr. Decker. Much has been accomplished in the past year or so. A little over a year ago in January 1989, the DOE selected Universities Research Association (URA) as the Management and Operations contractor for the SSC Laboratory. The selection of the Texas site was also finalized last January. I am proud to say that the selection process has withstood the scrutiny of several GAO studies. Five full-length dipole magnets (and many shorter ones) have been tested in the past year and these have demonstrated the mechanical design and high-field capability of the magnets. A magnet acquisition strategy plan has been devised and the Request for Proposals for Phase II of the magnet industrialization program (engineering development and prototyping) is nearing completion. The Department has established an Office of Superconducting Super Collider reporting directing to me and we are now actively staffing the key positions in this office. The SSC International Plan has been written and was approved by an interagency committee; ground work meanwhile is being laid by the scientific community. Perhaps the most important milestone of the past year has been the establishment of the Laboratory and its key staff in Texas, with staffing now at about the 500 level. A major focus of the Laboratory has been the careful review of the SSC design and the development of the new site-specific design and cost estimate.

Mr. Chapman. When will we see a demonstration of the magnet industrialization program?

Dr. Decker. Contract award is expected late this fiscal year. Contractor personnel will immediately begin training at the DOE laboratories. By March 1991, industrial personnel at Fermilab are expected to be assembling long collider dipoles. A small number, perhaps ten, of these magnets will go into a string test beginning in March 1992, and results are expected by September 1992. In parallel with this, industrial optimization of the magnet design will take place, a production facility will be equipped, and prototype production will begin in December 1991. The situation with the magnet industrialization program is very fluid in view of the recent decision to redesign the collider dipole magnets. This information is our latest understanding, but may differ somewhat in detail from previous statements.

Mr. Chapman. Has the Department reconciled the role of Magnetic Fusion and Inertial Confinement Fusion?

Dr. Decker. The Department is moving toward reconciliation of the roles of Magnetic Fusion and Inertial Confinement Fusion. On March 5, Admiral Watkins announced the names of the 19 member Fusion Policy Advisory Committee, which will review the technical basis for the two programs and recommend a fusion policy based upon this review.

Mr. Chapman. Do these programs appear to be competitive?

Dr. Decker. Both programs have made steady progress toward their goals. The Fusion Policy Advisory Committee has been asked to review them on a technology basis and make a recommendation concerning the advisability of competing the two programs along the lines of the draft fusion policy. This review will be completed by September 30.

Mr. Chapman. What restructuring of the program has taken place and what further restructuring is planned?

Dr. Decker. No restructuring of either program has taken place at this time. It will be appropriate to consider restructuring options after the Fusion Policy Advisory Committee has provided the Department with its final report in September.

Mr. Chapman. Please explain the large increase over last year's funding in the request for Applied Plasma Physics under Capital Equipment.

Dr. Decker. The increase of $1,184,00 in the Applied Plasma Physics Capital Equipment subcategory is due primarily to two components. The first is a net increase of $255,000 required for the preparation of special research diagnostics to be used in the operational phase of the Confinement Physics Research Facility that begins in FY 1993. The funding is needed in this fiscal year because of the lead time required in procuring, assembling, and testing the equipment. The second component is a net increase of $757,000 for the acquisition of a number of computer work-stations that are capable of manipulating the output from the Cray Supercomputers at the National Magnetic Fusion Energy Computer Center. These work-stations will be used at laboratories engaged in the computing effort in support of the Tokamak Transport Initiative. The remaining part of the increase, $172,000, is to be used for experimental diagnostics in support of the Transport Initiative.

BASIC ENERGY SCIENCES

Mr. Chapman. I see that approximately level funding has been requested for the Engineering and Geosciences program. In light of the Department's ongoing development of a National Energy Strategy, do you foresee this program playing an enhanced role in the near future?

Dr. Decker. The approximate level of funding requested for Engineering and Geosciences reflects the need to meet the increasing cost of maintaining and operating important experimental facilities for which the Basic Energy Sciences program is responsible. I expect that the funding for fundamental research in the engineering and geosciences disciplines, as well as other basic research areas in the Basic Energy Sciences program and other Office of Energy Research programs, will receive very careful consideration as we move forward to development of the FY 1992 budget requests.

NUCLEAR PHYSICS

Mr. Chapman. I am pleased to see a definitive commitment to the Relativistic Heavy Ion Collider (RHIC). What contribution will this machine make to the nuclear physics program.

Dr. Decker. Science at its frontiers asks the most basic questions about our world, and since ancient times a key question asked of science has been, simply, what is the fundamental structure of matter? Throughout history, a deeper understanding of this question has had profound influence on our technology and on our culture. Advances in atomic, nuclear and particle physics over the past several decades have shown that this question is intimately linked to what is perhaps the deepest question of all: How did the universe begin and how did it evolve into the complex structures of atoms, molecules, stars and galaxies which make up the world in which we live, and what will be its ultimate fate. We know that our world is made up of atoms, and that at the core of each atom lies a nucleus. This nucleus consists of matter at the highest density of any in the known universe, and particles which make up this matter exert the most powerful of the forces yet discovered in nature--the so-called "strong interaction" force. Experiments with particle beams have revealed the neutron and proton as the building blocks of the nucleus, and it is now known that inside each neutron and proton lies a deeper structure made up of particles known as QUARKS. These quarks are so intimately bound within the observable particles of the nucleus that we see no evidence of them in our everyday experience, and they are inaccessible to ordinary scientific experiments. Yet the nature of these quarks and their interactions with each other is fundamental to the structure and properties of all matter in our universe. Scientists believe that the universe began with a

"Big Bang"--a spark of energy in which all matter in the cosmos began as a small volume which for a brief time was millions of times hotter than any star and of such extremely high density that the binding forces which keep the quarks hidden from our view today were completely overwhelmed. This hot, dense nuclear matter consisted of a gas (or a "plasma") of unconfined quarks. A few millionths of a second after the Big Bang, this quark gas then cooled enough to condense into the droplets of protons and neutrons that still exist after almost 20 billion years. With its ability to collide heavy nuclei at very high energies, RHIC will permit scientists to create in the laboratory the extreme conditions that existed a few millionths of a second after the Big Bang. Scientists will in this way be able to regenerate the hot, dense quark plasma--a state of matter as yet unobserved. By so doing, researchers will recreate the sequence of events as this quark gas cools, condenses, and forms nuclear particles. We know of no other way to create, much less study, nuclear matter in such a revealing form.

Mr. Chapman. What role do you foresee for the Alternating Gradient Synchrotron, particularly with the Department's renewed commitment to the RHIC?

Dr. Decker. The continued operability of the Alternating Gradient Synchrotron (AGS) is of critical importance to RHIC since it will be used to preaccelerate the heavy ions that will be further accelerated and then collided in the RHIC rings. At the present time, the AGS is used for a very interesting high energy physics research program, including studies of rare kaon decays, searches for predicted particle states, precise measurements of fundamental constants, and studies of spin physics using polarized protons. There is also, at present, a heavy ion research program in which studies preliminary to the RHIC experimental program are carried out. Periodic use of the AGS will be required during the construction period to prepare for full RHIC operation. We are planning to transfer the primary support of the AGS from the High Energy Physics program to the Nuclear Physics program prior to the time that RHIC is commissioned. Since injection of particles into RHIC requires only about a minute, two or three times a day, the AGS would continue to be available for other program uses, such as a continued High Energy Physics Program.

Statement of James F. Decker
Acting Director, Office of Energy Research
Department of Energy
FY 1991 Appropriations Hearings

Mr. Chairman and Members of the Subcommittee:

It is a pleasure to appear here today to present the FY 1991 budget request for the programs supported by the Office of Energy Research (ER). These programs are: High Energy Physics, the Superconducting Super Collider, Nuclear Physics, Basic Energy Sciences, Magnetic Fusion Energy, Biological and Environmental Research, Energy Research Analyses, University and Science Education, University Research Instrumentation, Multiprogram Energy Laboratories-Facilities Support, and supporting program direction.

Funding for these programs in FY 1991 is being requested under the two appropriations shown in Table 1, Energy Supply R&D and General Science and Research. The total FY 1991 budget request for ER's programs is $2.7 billion, an increase of $302 million over the FY 1990 appropriation of $2.4 billion. In his February 7, 1990, testimony before the House Committee on Science, Space, and Technology, Dr. Allan Bromley, Director of the Office of Science and Technology Policy, noted that, "federal support for basic research is an essential investment in the nation's scientiric and technological future." This request reflects the Administration's commitment to the key role played by science in enhancing the economic and technological well-being of the United States, as well as the quality of our lives. It also reflects our continuing commitment to excellence in the research programs supported by the Office of Energy Research. I would like to discuss the programs under the

Table 1
Office of Energy Research
Summary by Program
Budget Authority
($ in millions)

	FY 1989	FY 1990	FY 1991 Request
Energy Supply R&D			
Basic Energy Sciences	$ 534.3	$ 569.8	$ 648.7
Magnetic Fusion Energy	344.7	320.3	325.3
Biological & Environmental Research	250.8	308.7	338.8
Energy Research Analyses	3.8	3.8	3.7
University and Science Education	21.4	24.9	29.7
University Research Instrumentation	4.9	4.9	4.9
Multiprogram Energy Laboratories-Facilities Support	24.4	22.1	23.7
Advisory & Oversight Program Direction	3.3	3.3	4.3
Policy and Management	.7	.7	.9
Small Business Innovation Research	33.1	0	0
Subtotal	$1,221.4	$1,258.5	$1,380.0
General Science & Research			
High Energy Physics	$ 549.8	$ 582.1	$ 621.2
Superconducting Super Collider	98.1	218.6	317.9
Nuclear Physics	258.0	289.7	330.7
General Science Program Direction	2.6	3.0	3.9
Subtotal	$ 908.5	$1,093.4	$1,273.7
Total ER	$2,129.9	$2,351.9	$2,653.7

General Science and Research appropriation first, followed by those under the Energy Supply R&D appropriation.

HIGH ENERGY PHYSICS

The long-standing goal of the High Energy Physics program is to improve our understanding of the nature of matter and energy and of the basic forces that govern the world in which we live. One of the major objectives of high energy physics research is to develop a unified description, or single theory, that would describe all the interactions of matter and energy in the universe. Another major objective is to search for the most fundamental constituents of matter. To continue to expand our knowledge in these areas, the program must develop advanced technologies that are used in the accelerators and detectors required to carry out high energy physics research.

Over the years, the program has contributed significantly to the development of advanced technology in many areas critical to the United States' economy, such as large-scale computing, high-speed electronics, and low temperature superconductivity. The instruments of high energy physics research and the knowledge gained from this basic research program have found practical applications in our every day world: in medicine for diagnosis and treatment of illness, in the food industry for sterilization, in construction for inspection of structural defects, in law enforcement for the analysis of evidence, in computers and computer science, and in the making of computer chips.

In recent years, high energy physicists have developed an increasingly better understanding of the forces of nature and the unifying connections among them. The four known fundamental forces are the electromagnetic force, the weak force, the strong force, and the gravitational force. The search for a unified, or single, theory has been a reliable guide to physics research. It is a search for linkages between apparently diverse phenomena in an effort to discover underlying simplicity. A part of the progress in high energy physics has been the conceptual unification of the weak nuclear force and electromagnetic force into a single "electroweak" framework. In addition, a theory of the strong force has emerged which is consistent with experimental results. There is increasing anticipation that the unification of the strong nuclear and the electroweak forces into one "grand unified" framework may be possible, thus reducing the apparent number of forces in nature to two. The ultimate goal is a "super-grand" unification that would bring all of the forces in nature into a single unified framework.

This picture of nature in terms of the electroweak and strong forces and a small set of fundamental constituents of all matter is known as the Standard Model. While the most significant recent experimental results all reinforce the predictions of the Standard Model, there are still unanswered fundamental questions. For instance, have we discovered the ultimate constituents of matter or are there smaller particles inside the families of particles called "leptons" and "quarks" which we currently believe are the fundamental particles? Do we know all the forces of nature? Are all these forces only a manifestation of a single force? How does gravity fit into the Standard Model?

The ability to carry out forefront, exploratory research in High Energy Physics, and to pursue the answers to these questions, requires large particle accelerators, colliding beam devices, and large particle detectors. In the U.S., DOE supports three accelerator centers: the Fermi National Accelerator Laboratory (Fermilab), the Stanford Linear Accelerator Center (SLAC), and the Alternating Gradient Synchrotron (AGS) at Brookhaven National Laboratory (BNL). Each of these laboratories provides world-unique capabilities and is operated as a national facility available to qualified experimenters from around the world on the basis of the scientific merits of their proposals. The talented physicists attracted by these facilities have continued to conduct landmark research, some of it earning Nobel Prizes for the researchers. To push back the frontiers to new knowledge in this field and to maintain this pioneering program into the next century, construction of the Superconducting Super Collider (SSC) is necessary. The SSC, which will be discussed later in this statement, will be the largest scientific instrument ever built and will be a beacon for new discovery, scientific training for our youth, and a source of new technology for many decades.

The physicists who are planning and developing experiments to be conducted at the SSC will continue to be funded under the High Energy Physics program as has been the past practice for other accelerators. Similarly, most of those who will conduct research at the SSC will come from the university community, as is the case at the existing accelerators. More than 75 percent of the research done at U.S. High Energy Physics accelerator facilities is carried out by university-based scientists and graduate students. Their participation

is critical to the strength and vitality of the U.S. program, both in the production of research results and in the training not only of new physicists, but also of scientists and engineers in other disciplines.

Before turning to a discussion of the FY 1991 budget request, I would like to summarize some of the recent progress made by the university and laboratory scientists working at the three High Energy Physics accelerator facilities. The capabilities of the Tevatron at Fermilab allow scientists to observe a larger number of particle interactions than at any other facility in the world. Scientists there are searching for an as yet unobserved, but theorized, particle known as the "top quark" whose existence, if verified, would confirm predictions of the Standard Model. Based on analysis of the results of experiments run in 1989, Fermilab investigators have shown that the mass of the top quark must be greater than 78 billion electron volts (GeV). Thus, the search must continue through experiments at even higher energies which are available only at the Tevatron.

At SLAC, the recently completed Stanford Linear Collider (SLC) has demonstrated the concept of linear colliders. Using 50 GeV beams, SLC is providing crucial data on the feasibility of building a next generation of higher energy linear colliders to permit experimentation in a new energy region. The second goal of the SLC is to study the so-called Z^0 particle, believed to be the "carrier" of the weak nuclear force. Detailed study of this particle provides important tests of the Standard Model including a direct measurement of the number of generations of neutrinos, which are uncharged elementary particles. Thus far, scientists at the SLC have detected

more than 500 Z° particles at 7 energy levels. Using these particles, scientists made the first precise measurement of the width and mass of the Z° and have determined with a high degree of probability that, in conformance with the Standard Model, there are three generations of neutrinos.

At Brookhaven National Laboratory, the Alternating Gradient Synchrotron's (AGS) extensive facilities provide yet another different test of the Standard Model by studying the way (or mode) in which particles called "kaons" decay. Some of these decay modes occur very infrequently and thus are called rare decay modes. Using improved detectors, recent physics results have reduced the upper limits on the rates of decay for these rare decay modes to as low as one in three billion ordinary decays. The Standard Model predicts that these rare decays will occur at a rate lower than one in three billion. Ongoing studies will continue to provide experimental results for comparison with the predictions of the Standard Model.

FY 1991 HIGH ENERGY PHYSICS BUDGET REQUEST

The FY 1991 budget request for High Energy Physics is $621.2 million. Of the total amount, $494.2 million is for Operating Expenses, $88.2 million is for Capital Equipment, and $38.8 million is for Construction. (Tables 2 and 3).

The Operating Expenses request of $494.2 million provides for the continued participation of both experimental and theoretical university scientists and students who are critical to the success of the High Energy Physics program, as well as for the operation of the High Energy Physics accelerators: the

Table 2
General Science and Research
High Energy Physics
Budget Authority
($ in millions)

	FY 1989	FY 1990	FY 1991 Request
Operating Expenses			
Physics Research	$ 121.6	$ 131.1	$ 140.3
Facility Operations	246.4	260.2	278.7
High Energy Technology	62.9	71.6	75.2
Subtotal	$ 430.9	$ 462.9	$ 494.2
Capital Equipment	79.8	84.1	88.2
Construction	39.1	35.1	38.8
Total High Energy Physics	$ 549.8	$ 582.1	$ 621.2

Table 3
General Science and Research
High Energy Physics
Budget Authority
($ in millions)

Construction

Project	TEC	FY 1990	FY 1991 Request
AGS Accumulator/Booster (86-R-105)	31.7	4.9	0[1]
Fermilab Linac Upgrade (90-R-104)	22.8	4.6	12.0
Accelerator Improvements and Modifications	$ N/A	$ 13.9	$ 14.5
General Plant Projects (GP-E-103)	N/A	11.7	12.3
Total Construction		$ 35.1	$ 38.8

[1]Funding completed in FY 1990

Stanford Linear Collider, the Tevatron accelerator/collider, and the AGS. The Tevatron will conclude a major fixed target run which will be followed immediately by an extensive antiproton-proton colliding beam run. The latter will involve two major detector facilities: the upgraded CDF (Collider Detector at Fermilab) detector and the complementary new D-Zero detector which is scheduled for completion and commissioning in the summer of 1991. With these capabilities, the physics utilization of the Tevatron collider will effectively be doubled from its previous run.

Physics research at the SLC will emphasize use of the new polarized electron beam capability which will be commissioned during the year. This new capability has the same effect, for some measurements, as increasing the collision rate by a factor of 10. With this new polarized beam, the collision rate near the design level, and a new detector scheduled for completion late in 1990, we expect that the SLC will be at the leading edge of high energy physics research in FY 1991. The Positron-Electron Project will also be operated at SLAC utilizing the improved Time Projection Chamber detector.

The AGS will operate primarily for High Energy Physics rare kaon decay experiments. The new AGS Accumulator/Booster will be commissioned during FY 1991. It will improve the performance and capabilities of the AGS, in part by providing more intense beams, and will significantly increase the data collection rate for the experimental program.

The FY 1991 Operating Expenses request also includes funding to support long-range accelerator and detector R&D to develop the new concepts and

technologies that are essential to the efficient operation, continued enhancement, and extension of accelerator and detector capabilities.

The FY 1991 Capital Equipment request of $88.2 million will provide the particle beam-line components, detection apparatus, and data analysis systems essential to forefront High Energy Physics research. In FY 1991, priority will be given to final completion of two major new collider detectors, one for SLC and one for the Tevatron, and to an upgrade of computer and data analysis equipment at universities participating in the program.

The FY 1991 Construction request of $38.8 million includes continued funding for the Fermilab Linac Upgrade project, a key element in maintaining a productive research program with the Fermilab Tevatron in the years before the SSC becomes operational. The Construction request includes $12.0 million for this $22.8 million project. The Linac Upgrade will replace a portion of the existing accelerator hardware for which commercial replacement parts are no longer available. This upgrade will increase the output energy of the linac from 200 to 400 million electron volts. The increased output energy will increase both the Tevatron collider collision rate and the beam intensity for the fixed target program, thus permitting additional experiments and increasing the likelihood of observing rarer occurrences such as the creation of the top quark. The Construction request also includes $14.5 million for Accelerator Improvements and Modifications (AIM) and $12.3 million for General Plant Projects (GPP). AIM projects provide for improvements to research accelerators and related experimental facilities, while GPP projects address the need to upgrade general laboratory facilities. These projects are needed

to maintain the scientific effectiveness, reliability, and efficiency of High Energy Physics facilities.

SUPERCONDUCTING SUPER COLLIDER

Although scientists working in high energy physics have made great progress in understanding the basic structure of matter and the fundamental forces, many important questions remain unanswered. The SLC and Fermilab Tevatron, together with other High Energy Physics facilities, will keep the U.S. program competitive and at the forefront in the search for answers to these questions for the next several years. However, to push the frontiers of knowledge into the trillion electron volt (TeV) mass region, where new and exciting discoveries are anticipated, a new, more powerful particle accelerator, the Superconducting Super Collider, is required.

The SSC will allow physicists to continue along a path of research that has dramatically altered the way we live, though the consequences often are not apparent for many years. Man's first steps on the moon would have been impossible without the basic conceptual understanding of gravity developed centuries earlier by Galileo and Newton. Radio and television and all the other electronic wonders of our age rest on the understanding of electricity and magnetism developed during the last century by Faraday, Maxwell, and Hertz. Nuclear power and nuclear medicine can be traced to the quests in the first half of this century by Rutherford, Bohr, and Fermi for a deeper understanding of the atom and the nucleus. The positive impact on individual lives of the new knowledge gained through this research can be seen in many

areas. In nuclear medicine, for instance, it has been estimated that several million Americans each year receive medical diagnosis or treatment from techniques which were developed from the technologies and particle accelerators used in basic physics research. Striking examples include computer-assisted tomography (CAT), positron emission tomography (PET), and magnetic resonance imaging (MRI).

The SSC will be the world's preeminent facility for high energy physics research into the next century. The SSC is a proton-proton collider with an energy of 20 TeV per beam whose principal feature is two rings of approximately 10,000 superconducting magnets located in an underground tunnel 54 miles in circumference. The two rings of magnets will steer and focus the proton beams in opposite directions until they are made to collide at the various interaction regions where large detectors record the events for analysis by physicists. The SSC will permit scientists to explore this new trillion electron volt domain of physics which cannot be reached by any other facility either in existence or planned.

The SSC is a critical part of the Administration's initiative to strengthen the position of the Nation as a world leader in science and technology. It will be a symbol of the Nation's commitment to scientific leadership in this century and the next. We can be confident that the SSC will yield exciting discoveries and technological innovations that will likely affect major industrial and technological directions in the twenty-first century.

This past year has been one of significant achievement. In January 1989, the Department announced the selection of the site for the SSC in Ellis County, Texas, and the selection of Universities Research Association, Inc., as the management and operating contractor to establish the SSC Laboratory and to design, construct and operate the SSC. An interim laboratory facility has been set up in leased space in DeSoto, Texas, near the Ellis County site. The Laboratory currently has approximately 500 people on board.

Also during the year, the SSC Laboratory developed and presented to the Department a preliminary, site-specific design for the SSC along with a revised cost estimate and schedule. Design changes proposed by the Laboratory include increasing injection energy into the collider from 1 TeV to 2 TeV, increasing the inner diameter of the superconducting dipole magnet coils from 4 centimeters to 5 centimeters, increasing the circumference of the ring by about one mile to accommodate stronger beam focusing, and providing larger detector halls. These changes result from additional technical information that has recently become available. Results of the Tevatron collider operations, supercomputer simulations of SSC-like proton orbits, and experience with magnets at the HERA facility in West Germany indicate that these changes are necessary. These changes will ensure that the SSC will operate reliably at the design parameters of energy and collision rate with a minimum of commissioning time.

These design changes and updated cost estimates are likely to raise the cost of the SSC from $1-2 billion. The Department is concerned about the cost rising above the previous $5.9 billion estimate and is committed to keeping

the cost as low as possible. However, we want to be certain that the facility we build will meet the physics goals of the SSC and will operate productively soon after completion of construction. The Secretary has indicated that the Department supports the technical conclusions of a recent High Energy Physics Panel study that strongly reaffirmed that 20 TeV is the appropriate energy for the SSC. The Secretary also supports the proposed technical design changes. However, during the coming months, we will carefully review the new design and cost estimate and will develop a validated technical, cost, and schedule baseline for the SSC. This review, which will be carried out with assistance from outside technical consultants and the Department's Independent Cost Estimating Group, should be completed by about August 1990.

As the Committee is aware, the State of Texas has made a commitment to contribute approximately $1 billion towards the construction of the project. We have had a series of discussions with the State's representatives and we expect to reach agreement with them in 1990 on the scope and pattern of their contribution. We will also establish the so-called "footprint" for the facility that will enable Texas to identify the specific parcels of land required so that preparations for land acquisition can begin, and so that on-site activities needed to complete the Supplemental Environmental Impact Statement can be conducted. The SSC Laboratory has awarded a contract to the Lockheed Company to provide systems engineering and integration support. The Laboratory has also selected for contract negotiation an Architect-Engineer/Construction Management contractor to design and supervise construction of conventional facilities. In the near future, an industrial contractor will be selected competitively by the Laboratory to participate in

finalizing the design of the superconducting collider dipole magnets, to develop a cost-effective and reliable manufacturing process, to fabricate prototype magnets and to demonstrate the production process by fabricating a significant number of magnets using final production tooling.

The major focus of the ongoing research and development program continues to be the superconducting dipole magnets. The R&D program conducted over the past few years on the original magnet design accomplished its objective of developing a main line magnet configuration which provided the basis for proceeding with engineering development and with establishment of the manufacturing process. The emphasis of the program will now shift to developing a design for the revised magnet specifications recently proposed by the Laboratory which call for increasing the inner diameter of the superconducting coil from 4 centimeters to 5 centimeters and reducing the length of most of the magnets from 17 meters to 15 meters. We expect to have the first short model (1 meter) of a new design magnet tested late in 1990 and the first full length (15 meter) magnet completed in 1991.

Another important activity during the last year was the preparation of a plan for seeking international contributions. The plan was developed in cooperation with the Office of Management and Budget, the Office of Science and Technology Policy, the National Security Council, the National Science Foundation, and the Commerce and State Departments, as well as with other appropriate agencies within the Executive Branch. The plan sets out our international objectives, the policy and regulatory framework in which we will conduct the international negotiations, and the strategy for establishing

appropriate international agreements. Our proposed strategy builds upon the experience of the U.S. High Energy Physics program in international cooperation and the experiences of other major research laboratories in Europe and Japan. We recognize the need to apprise Congress of our international cost-sharing strategy but have postponed doing so pending our review of the preliminary site-specific design and cost estimates. We intend to brief Congress in the near future on the International Plan. We also recognize the need to notify Congress prior to entering into any final agreements on foreign contributions.

Foreign interest in the SSC was evident at an International Conference on Supercollider Physics and Experiments hosted by the SSC Laboratory in early October. About 20 percent of the approximately 600 participants were from overseas, thereby reflecting the considerable worldwide interest in the program. The SSC Laboratory has also organized several advisory committees, which include foreign scientists, to seek the best scientific advice in order to optimize the machine's design, and to conduct the most appropriate experimental research program consistent with available resources.

FY 1991 BUDGET REQUEST FOR SUPERCONDUCTING SUPER COLLIDER

The FY 1991 budget request for the Superconducting Super Collider (SSC) is $317.9 million. That request includes $116.0 million for Operating Expenses, including $5.7 million for Program Direction; $33.0 million for Capital Equipment; and $168.9 million for Construction. (Table 4).

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Table 4
General Science and Research
Superconducting Super Collider (SSC)
Budget Authority
($ in millions)

	FY 1989	FY 1990	FY 1991 Request
Operating Expenses			
Research and Development	$ 81.6	$ 68.0	$ 110.3
Program Direction	0.5	0.9	5.7
Subtotal	82.1	68.9	116.0
Capital Equipment	16.0	20.7	33.0
Construction (90-R-106)	-	129.0	168.9
Total SSC	$ 98.1	$ 218.6	$ 317.9

The Operating Expenses request of $116.0 million provides for an enhanced level of R&D for the superconducting magnets and to support the transition to industrial fabrication of pre-production magnets which is planned for FY 1992. The request will allow substantial work on the conceptual design of other collider systems, including the focusing and correction magnets, cryogenics and the injector system. The request will also support a needed expansion in the detector subsystems R&D program.

The Capital Equipment request of $33.0 million will provide for prototypes in support of the R&D activities on the many accelerator components and systems of the collider and its four injector accelerators, such as power supplies and test and control instrumentation. The request also provides for components for the magnet test facility. Further equipment funds will also be used for prototypes of detector subsystems and components as SSC experiments and detectors become more completely defined, as well as for general laboratory and computer equipment essential for establishing a new research laboratory.

The FY 1991 Construction request of $168.9 million will allow construction-related activities to proceed in a number of areas, including detailed design of technical systems and conventional facilities, industrialization of magnets, procurement of materials for the magnet prototypes, initial fabrication of injector system components, site preparation, and project management and support. No tunneling construction is expected to occur until a decision has been made to go to commercial production of the superconducting magnets.

The FY 1991 budget request for SSC Program Direction is $5.7 million. The requested funds are required to provide for the salaries, benefits, travel and other expenses associated with 52 full-time equivalent employees for the Office of Superconducting Super Collider, both at Headquarters and at the SSC on-site Project Office. The new management organization for the SSC is consistent with the Secretary's objective of strengthening Departmental management of its large projects. It provides direct line management authority including an on-site office reporting directly to the headquarters program office, with significant expertise in the area of project management and control.

NUCLEAR PHYSICS

Nuclear processes determine the physical characteristics of our universe. Thus, an understanding of nuclei and nuclear phenomena is essential to understanding the world around us. The science of nuclear physics has spawned many diverse technologies, including nuclear weapons, nuclear power, and nuclear medicine. While these technologies are mature and are conducted independently of the research program, vital interactions still occur in the pursuit of better theories of nuclear structure and reactions, in the development of advanced instrumentation of mutual interest, and in the need for more precise data in selected areas.

The interaction between nuclear physics and other disciplines can be seen in many areas, including medicine and basic materials research. In the area of medicine, Nuclear Physics accelerators provide the facilities for the

diagnosis and treatment of cancers using beams of charged particles. Extensive and diverse cooperation also occurs in the area of activation analysis, a nondestructive nuclear technique using small neutron generators to identify, in detail, the composition of complex materials. For example, neutron activation is a widely used technique in oil exploration to identify the substances through which a well test bore passes. Use of this technique to identify trace element impurities shows promise for improving the clean burning of coal; and nuclear physicists active in heavy ion research have helped perfect a process which uses activation analysis to identify plastic explosives that might be smuggled aboard aircraft in the luggage of terrorists.

These applications of basic research are made possible by a growing fundamental understanding of the materials and forces of nature. Over the years, many theoretical models have been developed to describe the structure of the nucleus and its behavior. Models in which nuclear matter is treated as a fluid (liquid drop model) or an organized collection of nucleons (shell model) have been highly developed. More fundamentally, scientists now know that neutrons and protons, the constituents of the nucleus that are called nucleons, are composed of smaller constituents called quarks. These quarks are believed to be bound together in tightly knit groups of threes. Despite many attempts, scientists have not been able to isolate single quarks outside the nucleus. It is as if quarks were tied together by elastic strings that cannot be broken. This confining mechanism forms the basis of the newest theory of the strong nuclear force, called quantum chromodynamics (QCD). Many aspects of this theory are addressed both by the Nuclear Physics and High

Energy Physics research programs. However, only the Nuclear Physics program emphasizes tests of QCD predictions of quark behavior in nuclear matter. Only within the medium of nuclear matter can an individual quark be separated from its tightly knit group and studied as a free entity.

The Nuclear Physics research program is carried out at accelerator facilities around the country. Accelerators located at Lawrence Berkeley Laboratory (LBL), Argonne National Laboratory (ANL), Oak Ridge National Laboratory (ORNL), Los Alamos National Laboratory (LANL), Brookhaven National Laboratory, and the Massachusetts Institute of Technology (MIT) support broad research programs with experimental time allocated on the basis of scientific merit. Smaller facilities dedicated to in-house research are located at Yale University, the University of Washington, Triangle Universities National Laboratory, and Texas A&M. In addition, nuclear physics research is performed using experimental facilities located at High Energy Physics accelerators.

In FY 1990, Nuclear Physics accelerators continued providing beams for a vigorous research program. Operating time which was increased at the LBL 88-inch cyclotron and at the Tandem/AGS facility at BNL in FY 1989 will continue in FY 1990. Operations at the Clinton P. Anderson Meson Physics Facility at LANL were enhanced by the start of research using a new source of polarized protons which permitted new detailed measurements of nuclear structure. The LBL Bevalac produced record intensities of uranium beams for its heavy ion research program as a result of continuing improvements and modifications to its accelerators. Similarly, the Holifield Heavy Ion Research Facility at

ORNL achieved a new high in terms of both research hours and number of users, with the latter representing 50 institutions.

The experimental research program based on the use of these facilities was also very productive. At ANL, the phenomenon of super deformation was extended to a new region of nuclear masses. Deformed nuclei roughly take the shape of a football. Superdeformed nuclei are approximately twice as elongated as a football. Existing theories cannot explain the transition of nuclei into these shapes. The proposed Gammasphere detector, a gamma ray detector for nuclear structure research which consists of 120 separate and complex Germanium detector units is designed to address this rapidly evolving area. At the Bates Linac at MIT, an international scientific team made the first complete measurement of the charge distribution of the deuteron, which is composed of one proton and one neutron. New techniques and more precise data identified a deformed as well as a spherical component of the electric charge distribution of this simplest possible composite nucleus. The aspect of the nuclear force that gives rise to this deformation could form the basis of improved theories of superdeformation. A combination of results from experiments using the Tandem/AGS at BNL and the Super Proton Synchrotron at the European Organization for Nuclear Research (CERN) have measured the temperature of nuclear matter produced by relativistic heavy ion collisions. These experimental results, combined with extended theoretical calculations, confirm that even higher temperatures will be produced by the proposed Relativistic Heavy Ion Collider (RHIC) facility, which I will discuss shortly. RHIC will permit temperatures high enough to study, for the first time, the

quark-gluon plasma, the fundamental quark particles in the nucleus, and the strong force that holds them all in place.

FY 1991 NUCLEAR PHYSICS BUDGET REQUEST

The FY 1991 budget request for the Nuclear Physics program is $330.7 million. Of that total, $215.5 million is for Operating Expenses, $26.7 million is for Capital Equipment, and $88.5 million is for Construction (Table 5).

The FY 1991 Operating Expenses request will maintain an approximately constant level of program activity in low and medium energy physics, in heavy ion nuclear physics, and in nuclear theory. The FY 1991 request provides for an increased level of support for the Continuous Electron Beam Accelerator Facility (CEBAF) with $12.2 million allotted to R&D, testing and prototyping of accelerator components and support of detector development, and $12.4 million for start-up of laboratory operations and accelerator commissioning. Already, 245 physicists from 60 institutions have submitted 47 research proposals for experiments at CEBAF. From these proposals, a program of experiments will ultimately be selected to be carried out when the facility goes into operation in FY 1994. Special emphasis will continue to be placed on effective use of the upgraded accelerators at the University of Washington, Texas A&M University, and Yale University as well as the Alternating Gradient Synchrotron at Brookhaven. At the University of Washington, the second year of operations of the Nuclear Theory Institute will provide an increased number of study programs and workshops.

Table 5
General Science and Research
Nuclear Physics
Budget Authority
($ in millions)

	FY 1989	FY 1990	FY 1991 Request
Operating Expenses			
Medium Energy Nuclear Physics	$ 85.2	$ 92.4	$ 101.0
Heavy Ion Nuclear Physics	66.5	67.6	72.9
Low Energy Nuclear Physics	24.5	26.3	28.1
Nuclear Theory	10.8	12.2	13.5
Subtotal	$ 187.0	$ 198.5	$ 215.5
Capital Equipment	$ 18.5	$ 19.7	$ 26.7
Construction	52.5	71.5	88.5
Total Nuclear Physics	$ 258.0	$ 289.7	$ 330.7

Research and development in support of the next generation of accelerators will also be supported by the Operating Expenses request, including work at BNL to extend the scientific and technical basis for the proposed Relativistic Heavy Ion Collider.

The Capital Equipment request of $26.7 million will provide for instrumentation required to effectively use the national accelerator facilities operated by the program. These funds will provide such equipment as particle detection systems, data acquisition and analysis systems, and instrumentation to improve the performance of the accelerators. The Capital Equipment request also includes funds to start assembly of the Sudbury Neutrino Observatory, a laboratory for neutrino astrophysics, to be built as a collaborative U.S., Canadian, and United Kingdom project. The request also includes funds to begin fabrication of Gammasphere, the gamma ray detector for nuclear structure research that I mentioned earlier. Finally, the FY 1991 request will provide for general purpose equipment to meet the laboratory-wide needs of LBL.

The FY 1991 Construction request for Nuclear Physics is $88.5 million. (Table 6) Of that amount, $65.0 million is for CEBAF, an accelerator with electron beams in the energy range of 0.5 to 4.0 GeV that will provide access to the critical transition region between the traditional (i.e., nucleon) and the emerging (i.e., quark) descriptions of nuclear matter. CEBAF is expected to revolutionize the production and collection of data for nuclear physics research in the area of electromagnetic interactions with nuclei. The FY 1991 construction funds will be used for continued construction of the beam

Table 6
General Science and Research
Nuclear Physics
Budget Authority
($ in millions)

Project	Construction TEC	Construction FY 1990	Construction FY 1991 Request
Continuous Electron Beam Accelerator Facility (87-R-203)	265.0	62.6	65.0
Relativistic Heavy Ion Collider	397.0	-	15.0
Accelerator Improvements and Modifications	$ N/A	$ 4.5	$ 4.3
General Plant Projects	N/A	4.4	4.2
Total Construction		$ 71.5	$ 88.5

enclosure tunnel and support structures as well as for major hardware fabrication of radio-frequency cavities, cryounits, the central helium liquefier and transfer lines, and the linac and arc magnets.

The Construction request also includes $15.0 million to initiate construction of the Relativistic Heavy Ion Collider (RHIC). The Department's Nuclear Science Advisory Committee and the National Research Council have both confirmed the importance of this facility which will provide unprecedented opportunities to produce and study ultradense matter. With a Total Estimated Cost of $397.0 million, RHIC will be a unique, world-class facility with colliding beams that provide collision energies of 100 GeV per nucleon for heavy ions as massive as gold nuclei. At these energies, scientists will be able to form a unique kind of matter called a quark-gluon plasma which will create conditions in the laboratory that are similar to those of the expanding universe moments after the Big Bang. In this plasma, quarks will be separated from their tightly knit clusters and will move independently through the interior of a nucleus. The accelerator will be built in the existing circular tunnel at BNL. FY 1991 construction funds will be used to purchase superconducting wire for fabrication of arc magnets. In other areas, systems engineering and design will be carried on during the first year of the project.

The Construction request also includes $4.3 million for Accelerator Improvements and Modifications (AIM) and $4.2 million for General Plant Projects (GPP). AIM projects provide for improvements to research accelerators and related experimental facilities, while GPP projects address

the need to upgrade general laboratory facilities. These projects are needed to maintain the scientific effectiveness, reliability and efficiency of Nuclear Physics facilities.

GENERAL SCIENCE PROGRAM DIRECTION

The FY 1991 budget request for General Science Program Direction is $3.9 million. The requested funds are required to provide for the salaries, benefits, travel, and other expenses associated with 46 full-time equivalent employees in the Office of High Energy and Nuclear Physics and associated support staff required to administer these programs.

BASIC ENERGY SCIENCES

Basic research is the first link in the chain of events from scientific discovery to technological innovation. Results from research sponsored by the Basic Energy Sciences (BES) program help form the information base that underpins the Nation's nuclear and non-nuclear energy technologies. While the principal focus of the BES program is directed toward supporting the Department's energy goals, a number of other important national goals are also supported, including U.S. leadership in science and technology, the stimulation of economic growth and national defense, and the training of tomorrow's scientists.

Research in the BES program is grouped into six major subprogram areas: Materials Sciences, Chemical Sciences, Applied Mathematical Sciences,

Engineering and Geosciences, Advanced Energy Projects and Energy Biosciences. Research in each of these areas is primarily driven by the need for enhanced knowledge or understanding which currently limits existing technologies. The link between basic research and applications, however, is not generally confined to any single energy or technology problem. For example, a new or improved ceramic material may be applied to energy systems--whether they be fossil, nuclear, or automotive--or that material may provide an effective way to immobilize and store radioactive waste. Each of the BES subprograms supports research projects which have applications across a broad range of technologies. Whether the issue is how to burn fuel more efficiently or how to safely and cost-effectively dispose of waste materials, the solution to the problem depends on the results of basic research and the application of those results to the appropriate technology.

In addition to supporting research over a wide range of technical areas, the BES program provides support for the operation of major user facilities such as synchrotron radiation sources, neutron sources, and the Combustion Research Facility at Sandia National Laboratories (Livermore). These national facilities are maintained and operated for the benefit of all qualified researchers from Government laboratories, academia, and industrial laboratories. The seven major BES user facilities are critical to the success of the BES research program and are playing an increasingly important role in research carried out by the private sector. At the synchrotron light sources, for instance, the largest U.S. companies are doing research in such areas as catalysis and electronics; and major oil companies are investigating the porosity of geologic formations using the neutron sources. Advances in

materials, chemistry, biology, and the next generation of computer chips truly depend on these facilities.

During the last year, the Department carried out an extensive review of its nuclear facilities. Based on this review, the Secretary decided to transfer management of all nuclear research reactors, including BES's High Flux Isotope Reactor and High Flux Beam Reactor, to the Assistant Secretary for Nuclear Energy. The respective program offices retain responsibility for funding and directing these scientific facilities.

Approximately 60 percent of the BES-supported research is carried out at the national laboratories where all but one of the user facilities are located. Since these laboratories are also involved in many aspects of the applied energy programs, they are skilled at facilitating the transfer of scientific information and technology from experiment to application. The BES program also provides significant direct funding support to universities, in addition to providing them with research time at the various user facilities.

Every year there are important results in each of the research areas supported by the BES program. Some of the most interesting recent results include:

- Surprising research results discovered by Nobel Laureate Y. T. Lee at LBL. These results were obtained using molecular beams to study chemical reactions of energetic benzene molecules. Benzene is a minor but common constituent of many fuels and thought to be a major contributor to soot formation. Using laser radiation, Professor Lee is

able to cause individual benzene molecules to begin to degrade chemically, just as they would do in the environment characteristic of combustion. His experiments have demonstrated surprisingly extensive rearrangements of benzene's constituent hydrogen and carbon atoms - much more extensive than would have been anticipated from conventional chemical wisdom. This research has potentially far-reaching implications for chemistry and, ultimately, for the design and control of optimum combustion systems.

- Development at Ames Laboratory of a new, simple, and efficient way to synthesize silicon carbide. This new approach, which makes it possible to produce silicon carbide in the form of fibers, is likely to cut both the time and the cost of current commercial production of silicon carbide fibers. Materials containing these silicon carbide fibers are replacing metal in industrial and military applications due to their strength, low weight, high heat tolerance, and resistance to chemical breakdown. A patent application has been filed, and several industrial concerns have expressed serious interest in this new development.

- Development by scientists at the Princeton Plasma Physics Laboratory of an X-ray laser microscope that is capable of revealing the details of biological systems. This accomplishment, which was recognized by a 1989 R&D 100 Award, allows scientists to take pictures of living cells and observe such processes as the invasion of a virus. The availability of this microscope is expected to greatly expand our ability to study the structure and dynamic processes of biological cells.

- Development of a new imaging technique at ORNL that can "see" new details of defects in high temperature superconductors and many other materials. Using this technique, scientists have learned that the achievement of high critical current densities in the oxide superconductors depends strongly on the geometry of certain defects. These high current densities are one requirement for practical applications of high temperature superconductors in electric motors, generators, and transmission lines. This result leads to renewed optimism that current densities in high temperature superconductors can be raised to useful levels.

- Development at ANL of a new class of chemicals for environmental and nuclear waste applications. These chemicals, called thermally unstable complexants, are environmentally compatible chemical clean-up agents. They remove transuranic and other metal contaminants from waste streams to very low levels and, after further development, could be applied to nuclear wastes, ground water, and metallurgical processes.

- Development of a mathematical technique that makes possible computer modeling of the propagation of cracks in materials, such as airplane fuselages and engine fan blades. The annual cost of fracture related damage in the U.S. has been estimated at over $10 billion. This new mathematical technique, discovered at Oak Ridge National Laboratory, has been implemented in a structural analysis computer program by

Cornell University to form a useful tool in material structure studies.

FY 1991 BASIC ENERGY SCIENCES BUDGET REQUEST

The FY 1991 budget request for Basic Energy Sciences is $648.7 million. The request includes $503.7 million for Operating Expenses, $37.0 million for Capital Equipment, and $108.0 million for Construction. (Table 7)

The Operating Expenses request maintains a strong core research program in each of the BES subprograms. Research in Materials Sciences continues to improve our theoretical and experimental capability to analyze the fundamental structure and behavior of materials. In doing so, materials research contributes to the development of new or substitute materials that can improve performance and efficiency in energy systems. It creates the capability to tailor materials properties to satisfy defined requirements, such as improved corrosion resistance in fossil plants, and to predict materials problems and service life. The 1991 request of $222.0 million will provide for continuing research programs in high temperature superconductivity, solid state physics, materials chemistry, metallurgy, and ceramics. Funding for support of major user facilities is also included in this request.

The Chemical Sciences subprogram, with an FY 1991 request of $150.5 million, investigates the chemical properties of matter and the interactions of the component molecules, atoms, ions, and electrons. Chemical sciences research ultimately affects such areas as production of fuels and chemicals from coal, nuclear waste separation, conversion of biomass (such as wood and leafy

Table 7
Energy Supply R&D
Basic Energy Sciences
Budget Authority
($ in millions)

	FY 1989	FY 1990	FY 1991 Request
Operating Expenses			
Materials Sciences	$ 173.7	$ 198.7	$ 222.0
Chemical Sciences	127.8	140.3	150.5
Applied Mathematical Sciences	42.1	43.7	48.0
Engineering and Geosciences	32.8	33.2	32.5
Advanced Energy Projects	14.3	14.6	24.0
Energy Biosciences	20.4	20.6	20.2
Program Direction	4.9	5.4	6.5
Subtotal	$ 416.0	$ 456.5	$ 503.7
Capital Equipment	31.7	36.5	37.0
Construction	86.6	76.8	108.0
Total Basic Energy Sciences	$ 534.3	$ 569.8	$ 648.7

materials) into liquid fuels, and detection and measurement of harmful products of energy processes. In FY 1991, the research program will emphasize areas relevant to the environment, waste management, and combustion. The FY 1991 budget request also includes support for major user facilities.

Applied Mathematical Sciences supports long-range mathematical and computational research. Computational methods provide insights into experimental data and simulate ideal experiments for testing analytical models. This subprogram advances all aspects of scientific computation--from proofs of theorems about mathematical equations to understanding the structure of parallel computer systems. With an FY 1991 request of $48.0 million, Applied Mathematical Sciences will continue to provide access to, and expand the capabilities of, the supercomputer network that is essential for researchers supported by the Office of Energy Research. Selected increases will be provided for research, fellowships, and problems identified in the Government-wide initiative in high performance computing. This initiative, which is being coordinated by the Federal Coordinating Committee on Science, Engineering and Technology (FCCSET), recognizes the need to maintain and extend U.S. leadership in high performance computing. As a major user of high performance computing and a pioneer of the use of supercomputers for modeling complex physical systems that are too dangerous, expensive, or poorly understood to build and test, DOE strongly supports this initiative and looks forward to playing a key role in achieving its objectives.

The Engineering and Geosciences subprogram, with an FY 1991 request of $32.5 million, includes two broad disciplines. Research in engineering aims to

expand our knowledge of the processes and concepts that underlie current engineering practice in energy technologies and to broaden the technical and conceptual base for solving future problems. The FY 1991 request will continue fundamental engineering research with emphasis on topics important for energy production and use, as well as those meeting the Department's long-term objectives for restoration of the environment. Such topics include flow of oil, gas, and water through porous materials such as soil and rocks and two phase flow in energy systems--for instance, mixtures of water and steam in nuclear reactors. Work is also underway on what are called intelligent machines, for example, the mobile robots to be used for cleanup of contaminated sites. In Geosciences, the research emphasizes the development of a predictive understanding of the energy-related aspects of geological, geophysical, and geochemical process related to the Earth. Emphasis in FY 1991 will be on high-resolution underground imaging related to enhanced oil recovery and waste management, as well as on continental scientific drilling. In the latter area, site studies to investigate existing geological structures will be carried out at Katmai, Alaska where drilling is scheduled to start in FY 1992.

The Advanced Energy Projects subprogram, with an FY 1991 request of $24.0 million, explores the feasibility of novel, energy-related concepts evolving from basic research that are at an early stage of scientific definition and, therefore, are not yet of practical use to technology programs. In FY 1991, research will continue on heavy ion accelerators with the goal of validating this technology as a possible inertial fusion driver; and additional funds will be provided on a cost-shared basis with industry to transfer synchrotron

radiation technology (x-ray lithography) to industry for use in developing next generation computer chips.

The FY 1991 request for the Energy Biosciences subprogram is $20.2 million. Research in this area continues to increase our understanding of basic biological principles, biological mechanisms, and organisms useful for energy applications, such as the production of fuels from biomass materials. In FY 1991, this subprogram will continue its base program in plant and microbial sciences, including support for the plant science centers supported jointly by the Department, the National Science Foundation, and the Department of Agriculture.

The Program Direction request for FY 1991 is $6.5 million. This request will provide funds for the salaries, benefits, and travel related to 70 full-time equivalent staff.

The BES Capital Equipment request for FY 1991 is $37.0 million. These funds will ensure that BES-supported researchers will continue to have the equipment needed to initiate and continue advanced research, much of which involves experiments at extremes of temperature and pressure. Reliable, precise measurements under these conditions challenge the current state-of-the-art. Replacements and new equipment funded under this request, which are important to the continued success of the program, include such items as electron microscopes, neutron spectrometers, molecular beam equipment and computers for equipment control and data analysis.

The FY 1991 Construction request of $108.0 million (Table 8) includes continued funding for the construction of the 1-2 GeV Synchrotron Radiation Source at LBL as well as the 6-7 GeV Synchrotron Radiation Source at ANL. Both facilities are needed to cover the entire radiation range needed for experiments supported by the BES program. The 1-2 GeV project is a third generation light source in the vacuum ultra violet/soft x-ray range. The unique capabilities of this facility will make possible new basic and applied science studies in such areas as materials and surface science, atomic and molecular physics, chemistry, and biology. The FY 1991 request includes $23.0 million for this project. The 6-7 GeV project is a new, hard x-ray synchrotron light source which has been rated as the top priority by several scientific panels, including one from the National Academy of Sciences. It will provide brilliant x-ray beams that will serve the research needs of virtually all scientific disciplines and many technology fields. The FY 1991 request for this project includes $75.0 million to continue accelerator and conventional facility construction. Of the remaining $10.0 million, $7.0 million is for Accelerator Improvements Projects and $3.0 million is for General Plant Projects. Each of these categories is comprised of smaller projects which are necessary to maintain plant and facilities at several DOE laboratories. The projects include a wide spectrum of improvements necessary to protect property and personnel and to modify existing scientific facilities to allow the most cost-effective utilization of their technical capabilities.

Table 8
Basic Energy Sciences
Construction Summary
($ in millions)

Project Title	TEC	FY 1990	FY 1991 Request
1-2 GeV Synchrotron Radiation Source (LBL)	$ 99.5	$ 25.6	$ 23.0
3 GeV SPEAR Injector (SSRL)	14.0	4.5	0
6-7 GeV Synchrotron Radiation Source (ANL)	456.0	39.4	75.0
Accelerator Improvements Projects	N/A	4.5	7.0
General Plant Projects	N/A	2.8	3.0
Total Basic Energy Sciences Construction		$ 76.8	$108.0

MAGNETIC FUSION ENERGY

Fusion is the process by which the sun and other stars produce energy. The continuing goal of the Magnetic Fusion Energy program is to develop theory and conduct experiments to determine how fusion reactions can be controlled and used to produce energy. Steady progress has been made but the scope of work is formidable. Fusion is an attractive source of energy for several reasons. The fusion fuels (deuterium and tritium) are easily obtained and virtually inexhaustible. In addition, fusion reactors can be designed to yield very little long-lived radioactive waste. Finally, fusion powerplants would have attractive safety features because there would be only small amounts of relatively low-hazard fuel present at any one time and the fusion reaction could not run out of control.

The path to successful development of magnetic fusion energy for practical use requires development of a device that can heat the deuterium-tritium fuel to the required high temperature and confine the heated fuel long enough so that more energy is released in the fusion reactions than is used to heat the fuel; in other words, a significant energy gain is achieved. The leading candidate for confining the hot plasma fuel is a donut-shaped magnetic configuration called a tokamak. The program is currently trying to enhance its understanding of energy confinement in order to clarify the requirements for significant energy gain. In addition, research and development are required to improve the potential economics of fusion. Finally, the Magnetic Fusion Energy program is participating in the initial phase of an integrated world-wide program whose long-term objective is to establish the science and

technology base for fusion and, thus, create opportunities for the U.S. to benefit from collaboration on major facilities.

The program is organized around four key technical issues. The first is understanding how the plasma behaves once fusion reactions are producing sufficient heat to maintain reacting or burning conditions. The second is determining the best confinement configuration by studying potentially improved devices or fuels. The third issue involves research on materials to see which ones provide the best safety margin and the lowest levels of induced radioactivity when introduced to a fusion reactor environment. The fourth issue requires the development of the nuclear technology to effectively and safely convert fusion energy to electricity.

The program currently emphasizes the first two issues. These efforts are aimed at developing a predictive understanding of the mechanisms that control energy confinement within the tokamak. Experimental data suggest that improved confinement will be required for the next generation of devices. Scientists have already observed this improved confinement in a number of tokamak devices. The program is working on developing the understanding necessary to apply these observed improvements to future devices.

Before I turn to a discussion of the FY 1991 budget request, I should note that an independent, high-level review of fusion will be carried out in FY 1990. The objective of the Fusion Policy Advisory Committee will be to review and update the Department's fusion policy, covering both the magnetic and inertial confinement programs. The Committee review will focus on the

technical status of the programs and will recommend how to structure them. The FY 1991 budget request provides for maintaining the current magnetic fusion program balance, with a focus on confinement physics. Budget estimates will be revised as necessary once the review is completed and the Department has determined what changes, if any, to make in the program.

FY 1991 MAGNETIC FUSION ENERGY BUDGET REQUEST

The FY 1991 budget request for Magnetic Fusion Energy is $325.3 million. This includes $291.9 million for Operating Expenses, $14.3 million for Capital Equipment, and $ 19.1 million for Construction (Table 9).

The Fusion budget is organized into five major subprograms: Confinement Systems, Applied Plasma Physics, Development and Technology, Planning and Projects, and Program Direction. Confinement Systems, with an FY 1991 Operating Expenses request of $163.0 million, operates large experimental devices and analyzes the data to improve our understanding of plasma behavior and to learn how to obtain and control the physical conditions necessary to ultimately produce fusion energy. Research is currently being conducted on several toroidal devices, primarily tokamaks, to investigate key physics issues and prepare for performing burning plasma physics experiments on future devices. One important aspect of present experimental research is the effort to obtain a better understanding of transport, or energy loss, in tokamak plasma systems.

Table 9
Energy Supply R&D
Magnetic Fusion Energy
Budget Authority
($ in millions)

	FY 1989	FY 1990	FY 1991 Request
Operating Expenses			
Confinement Systems	$ 172.7	$ 160.2	$ 163.0
Applied Plasma Physics	81.2	71.6	70.9
Development and Technology	54.1	47.4	48.1
Planning and Projects	1.1	4.2	4.2
Program Direction	4.6	5.0	5.7
Subtotal	$ 313.7	$ 288.4	$ 291.9
Capital Equipment	18.8	13.3	14.3
Construction	12.2	18.6	19.1
Total Magnetic Fusion Energy	$ 344.7	$ 320.3	$ 325.3

The Tokamak Fusion Test Reactor (TFTR) at Princeton Plasma Physics Laboratory (PPPL) is the largest U.S. tokamak, with a long-term goal of conducting plasma experiments using deuterium-tritium fuel at plasma temperatures and densities similar to those anticipated in a future fusion reactor. During the past calendar year, the TFTR program has focused on the energy transport issue. New diagnostics were fabricated and installed, and new techniques for obtaining improved confinement were developed. The Advanced Toroidal Facility at ORNL will contribute to the understanding of confinement in tokamaks, while Doublet III-D at General Atomics is the focal point for a variety of ongoing experiments on plasma transport. During the past year, scientists at Doublet III-D also achieved a new world record beta value for tokamaks. Beta is defined as the ratio of the plasma thermal energy to the magnetic pressure that is used to confine the plasma. Doublet III-D experiments achieved a peak beta value as high as 9.3 percent and sustained a beta value of 8 percent for almost a second. This is greater than the beta value thought to be necessary for economical fusion reactors. Abroad, the Joint European Torus in Great Britain has essentially reached equivalent energy breakeven conditions in deuterium, in other words, conditions where the energy released is equal to that required to heat the fuel.

Upgrades for microwave heating experiments on the Princeton Beta Experiment will be completed in FY 1990 and the device will resume its research operations aimed at operating under higher plasma pressure conditions in FY 1991. Fabrication of the Alcator C-Mod facility at the Massachusetts Institute of Technology will be completed in early FY 1991, and initial operations are planned for FY 1991. This facility will allow scientists to

study plasma performance with a compact, high-field, high-density design using improved plasma edge controls in support of a future burning plasma physics experiment. Preliminary design activities for the Compact Ignition Tokamak will continue to improve projected performance. Technology R&D will also be conducted in support of prototype development.

Applied Plasma Physics, with an Operating Expenses request of $70.9 million, plays a major role in addressing the magnetic confinement and burning plasma physics issues at a very fundamental level. The subprogram conducts research on potentially attractive advanced confinement configurations and on basic magnetic confinement physics. It also develops information on new diagnostics and techniques to heat and control plasma, and provides computational and theory support for the overall program. In FY 1991, this subprogram will continue to expand our understanding of magnetically confined plasma through experiments with various magnetic configurations, including tokamaks, compact toroids, and reversed field configurations. Fabrication of the Large S Experiment (LSX) will be completed at Spectra Technologies in FY 1990 to further investigate the potentially attractive field reversed configuration concept. The Confinement Physics Research Facility, under construction at the LANL, will improve our understanding of reversed field pinches once it is operating. I will refer to this project later when I discuss the program's Construction request.

In FY 1991, research on applied plasma physics theory will give special emphasis to modelling and understanding the process of controlling the transport of energy and particles in toroidal plasma. The Texas Experimental

Tokamak (TEXT) at the University of Texas will be operated with new electron cyclotron heating and diverter hardware in order to compare transport data with other tokamaks. Support is also provided for the continued operation of the computer center at LLNL and the five user service centers. The computing capability will be improved through faster network access and additional local computing work stations.

With an Operating Expenses request of $48.1 million, the Development and Technology subprogram will continue to support the development of technologies required for fusion experiments and the design and analysis of fusion systems. During the last year, the first phase of the tritium proof-of-principle pellet experiments was completed at the Tritium System Test Assembly at LANL. During those experiments, scientists from ORNL obtained information that demonstrates the feasibility of tritium pellet fueling for next-generation experiments.

A number of international collaborative programs will be supported in FY 1991, including the International Thermonuclear Experimental Reactor (ITER). The ITER process is developing into a successful and unique model for large-scale, equal participation, international projects. An Interim Conceptual Design Report has been completed, with the full Conceptual Design Report to be completed in December 1990. ITER-related technology R&D tasks have been defined and are under way in each of the participant countries as part of the $8.0 million ITER technology R&D funding provided by each participant. Physics R&D tasks are being undertaken on a voluntary basis by the home program of participating countries. The Massachusetts Institute of Technology has just completed a pulsed superconducting coil winding, which is expected to

be a technology applied to ITER for driving the plasma current. The coil will be shipped to Japan in March 1990 for joint testing by the U.S. and Japan. Successful operation of this large (2 meter) coil would be a major step in pulsed coil technology and would allow scale-up to full-sized, pulsed, superconducting ITER coils. With the conceptual design activity nearly completed, the U.S. will decide whether to enter discussions on the engineering design phase of ITER. A final decision on continued U.S. participation in ITER will depend on a variety of factors, including the recommendations of the Fusion Policy Advisory Committee and the outcome of the annual budget process.

The FY 1991 budget essentially provides for a continuation of FY 1990 activities. This includes such areas as development of high field, steady-state, pulsed magnets and plasma heating and fueling components, development of low activation and radiation-resistant structural materials that have acceptable characteristics for the fusion reactor environment, and tasks to enhance the environmental and safety advantages of fusion. Materials also need to be developed that can resist high heat flux and erosion by the bombardment of plasma particles. Fusion nuclear components will continue to be developed to produce and process tritium safely and convert fusion energy into useful forms.

Finally, systems design work aimed at developing improved reactor designs, including inertial confinement concepts, is supported. Support of design and validating R&D for ITER is also supported.

The Planning and Projects subprogram provides support for construction of major new facilities and fabrication of auxiliary components for these facilities. The FY 1991 Operating Expenses request of $4.2 million is primarily for compliance with requirements associated with the Small Business Innovation Research program.

The Operating Expenses request of $5.7 million for Program Direction provides for personnel and other costs associated with 64 full-time equivalent employees.

The FY 1991 Capital Equipment request of $14.3 million will provide for essential hardware to support the overall program. This equipment includes diagnostic and computer equipment, power supplies, and other components for experimental facilities.

The FY 1991 Construction request of $19.1 million (Table 10) provides $11.1 million for continued construction of the Confinement Physics Research Facility (CPRF) at LANL. The CPRF will provide an experimental capability to explore the physics properties of a reversed field toroidal confinement experiment that has the theoretical capability, in a future device, of heating the plasma to ignition with lower magnetic fields. The FY 1991 request will allow the program to complete fabrication of the coils and the vessel and shell, to begin installation of these components, and to complete generator start-up tests.

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Table 10
Magnetic Fusion Energy
Construction Summary
($ in millions)

Project Title	TEC	FY 1990	FY 1991
Confinement Physics Research Facility (89-R-800)	75.6	10.9	11.1
General Plant Projects	N/A	7.7	8.0
Total Construction		18.6	19.1

The remainder of the Construction request, $8.0 million, is for General Plant Projects (GPP). These GPP projects at LANL, PPPL, and ORNL provide for the continuing minor alterations and modifications necessary to protect the Government's investment in its facilities.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

The Biological and Environmental Research (BER) program supports research aimed at identifying, understanding, and anticipating the long-term health and environmental consequences of energy development and use. The program also contributes to the solution of major scientific problems in medicine and biology through the use of the Department's unique scientific and technological capabilities.

The BER research program, with its focus on human biology and health and on the environment, grew out of the program's initial mission to understand the potential health and environmental impacts of radiation. As definitive information was obtained concerning relatively high levels of radiation exposure, attention was turned to potential effects at lower doses that might be received by worker populations or the general public. This concern led to epidemiology studies on selected populations, such as contractor employees, and a more comprehensive research program involving experimental animal, cellular, and molecular studies.

The Department's human genome program represents a new approach, based on modern biology and technology, to the more than forty year old mission of evaluating effects of low doses of exposure to energy-related agents. The

knowledge that will flow from this program will open new levels of understanding about the effects of radiation and chemicals on the most fundamental level of life--the DNA molecule. Combined with the increased understanding of biological structure and function provided by research in structural biology, the results of these research activities are providing and will continue to provide methods, data, and processes for biotechnology applications. Potential applications include new drug designs, protein engineering of enzymes and other catalysts for industrial processes, diagnostics for medical diseases, and applications of biotechnology for environmental restoration.

The environmental research program, in a similar manner, evolved from an initial need to understand the pathways of radioactive materials from weapons testing through atmospheric, marine, and terrestrial environments to human exposure. The research base established within the DOE environmental research program has helped provide a quantitative understanding of the processes that affect the environmental fate of energy-related materials and, thus, has enabled DOE to respond effectively to recent national concerns such as acid rain and possible global warming from the increase of carbon dioxide and other greenhouse gases. Important research related to subsurface contamination and ground water is also underway and is expected to contribute significantly to environmental restoration activities.

The Department's research in medical applications also evolved from the original mandate to promote the use of radioactive materials for medical applications. As progressively sophisticated applications for diagnosis and

treatment of diseases evolved, nuclear medicine became a recognized medical specialty and radionuclide production developed into a flourishing industry. The Department's research in this very important field of medicine continues to produce new information and technologies that make possible more effective and safer ways to diagnose and treat a variety of diseases, including cancer and heart disease.

FY 1991 BIOLOGICAL AND ENVIRONMENTAL RESEARCH BUDGET REQUEST

The FY 1991 budget request for the BER program is $338.8 million. Of that amount, $323.7 is for Operating Expenses, $11.6 million is for Capital Equipment, and $3.5 million is for Construction. (Table 11).

The Health Effects research activity, with an FY 1991 Operating Expenses request of $73.1 million, will provide for continued research in epidemiology, radiation biology, and chemical toxicology. This research will provide the information needed to correlate the relationships between exposure to chronic, low levels of chemicals or radiation and the consequent biological response. In addition to increasing our scientific understanding of these relationships, results from this research will continue to provide input to occupational exposure standards and, ultimately, will lead to healthier and safer environments in the workplace.

The epidemiology research supported by the BER program is concerned with the health consequences of energy production and use as well as the consequences of working at or living near DOE facilities. Extensive data bases on the

Table 11
Energy Supply R&D
Biological and Environmental Research
Budget Authority
($ in millions)

	FY 1989	FY 1990	FY 1991 Request
Operating Expenses			
Late Effects on Health & Environment of Energy Development and Use			
Analytical Technology	$ 14.2	$ 15.2	$ 17.0
Environmental Research	36.3	40.5	44.7
Health Effects	64.9	71.5	73.1
General Life Sciences	45.4	56.2	80.2
Medical Applications	36.1	37.3	37.0
Carbon Dioxide Research	17.4	50.0	65.9
Program Direction	4.0	4.5	5.8
Subtotal	$ 218.3	$ 275.2	$ 323.7
Capital Equipment	9.0	11.3	11.6
Construction	23.5	22.2	3.5
Total	$ 250.8	$ 308.7	$ 338.8

Department's contractor worker population have been compiled in connection with studies of chronic exposures to ionizing radiation. In response to the need to organize and integrate data from these studies, as well as data on other DOE worker populations living near DOE facilities, and on other populations such as workers in the energy industry, the FY 1991 request includes a continued effort to develop the Comprehensive Epidemiologic Data Resource (CEDR). This resource will be available to all qualified epidemiologic research investigators.

The CEDR, which is one element of the Secretary's four-point epidemiologic initiative, will be a national database containing validated data useful for epidemiologic research. A draft of the CEDR program plan has been completed; working groups have been formed to develop full implementation plans; an interim version of the CEDR, containing some data for dissemination, has been completed; and acceleration of activities to complete data collection on DOE workers has begun. While we expect to have intermediate versions of CEDR available for dissemination during the development process, full implementation is scheduled for the end of FY 1995. A major programmatic review of the Department's epidemiologic research activities was started in 1989 by the Secretarial Panel for the Evaluation of Epidemiologic Activities. The Interim Report of the Panel to the Secretary was received in November, 1989. The Panel made a number of recommendations, including several related to the release of data on DOE workers to researchers outside of the Department. The Department is in the process of addressing the Panel's recommendations.

The FY 1991 Health Effects request also provides for continuing the basic scientific research needed to understand and predict the health risk associated with exposure to indoor radon. This research includes determining the availability and transport of radon in the environment and its behavior indoors. It also includes measuring and characterizing human exposure to radon more accurately, better defining health risk estimates, and determining the role of radon exposure in combination with smoking in causing lung cancer. Estimates of the risk of incurring lung disease from exposure to radon are derived from experience with exposures in uranium mines. Most of the smallest particles on which radon decay products are deposited become trapped in the nasal cavity and, thus, do not enter the lungs. Further research, which will include animal exposure studies and extension of current studies from model indoor systems to real residences, ~~this finding~~ could have implications for what are currently considered to be the exposure levels requiring corrective actions.

The FY 1991 request for General Life Sciences research is $80.2 million. This program will continue to emphasize molecular and cellular studies to examine how key biological processes operate, as well as studies of the structure of key macromolecules like DNA. Using this knowledge, researchers can learn more about how physical and chemical agents affect living processes. The research also identifies early indicators of biological damage, teaches us how cells repair themselves, and leads to new techniques for analyzing biological damage.

Much of the damage to DNA that is caused by radiation and chemicals is repaired by the body's own built-in defenses. This repair process has important implications for accurately evaluating the risks and potential health impacts of these agents. Advances in our understanding may even have considerable potential for therapy. Progress has been made during the last year at LLNL, LANL, and ORNL where researchers were able to isolate specific human genes involved in the repair of DNA damage caused by ultraviolet light and certain types of chemicals.

A major FY 1991 focus in General Life Sciences research will be the DOE human genome effort which is developing new instrumentation and methodologies that will make research on the molecular structure of the human genome, which is the complete set of genetic instructions that make a human being, less costly and less labor intensive. The FY 1991 request of $45.9 million expands human genome research aimed at developing improved technologies for sequencing DNA, constructing physical maps of each human chromosome, developing computational capabilities for analyzing and manipulating data, and facilitating technology transfer. During the last year, progress has been made at LANL, LLNL, LBL, and the University of Chicago, respectively, where scientists have developed: a new physical mapping technique currently in use in mapping chromosome 16, an automated technique being used to map chromosome 19, a common language that would allow all physical maps of chromosomes to be described electronically, and a new method of cutting human DNA into fragments that will greatly facilitate chromosome mapping. Also during the last year, DOE and the National Institutes of Health (NIH) completed a five-year plan for the national human genome program which DOE and NIH jointly plan and carry out.

The DOE portion of the program focuses on developing technical capabilities and tools, while the NIH effort is oriented toward characterizing disease-oriented genes, through use of both human and non-human model systems.

The FY 1991 request for Analytical Technology is $17.0 million. This request will provide for research directed at developing new and more sensitive instruments to make physical, chemical and biological measurements of energy-related emissions. These instruments will also assist scientists in measuring human exposure and biological response to those emissions. These more precise measurements are crucial to further progress in understanding indoor radon, as well as damage to DNA and to the environment from energy-related missions.

The FY 1991 budget request for Environmental Research is $44.7 million. This research activity, together with the Carbon Dioxide Research activity, which I will discuss next, provides information needed to address a number of important issues, including atmospheric chemistry, global climate processes, the resiliency of ecosystems and marine coastal areas to energy activities, and environmental restoration around DOE facilities that have been used for energy and weapons-related operations and R&D.

The Environmental Research request will provide for continued research aimed at determining how energy-related agents move through and are changed by the atmosphere, oceanic and terrestrial ecosystems, and how they ultimately affect humans. Scientists are also looking at how the environment itself may be affected by energy-related activities and how negative effects can be mitigated.

The FY 1991 request will also support a series of major field studies of the processing of sulphur and nitrogen oxides by clouds and precipitation, and the mechanisms by which they are deposited on sensitive ecosystems. This work will contribute to a more informed approach to possible emission control strategies aimed at addressing the acid rain problem.

Long-term research directed at contamination of subsurface sediments and ground water by mixed wastes from DOE sites will also be carried out. This research provides the underpinning for cost-effective management and remediation of contamination from the Department's energy and weapons-related project wastes. One example of the productive results stemming from research in this area is the recent development at Pacific Northwest Laboratory of an innovative sensor for detecting liquid contaminants such as fuel oil or solvents within soil. This sensor is less expensive, simpler, and more accurate than existing sensors, and the technology is now available to industry for commercialization. In FY 1991, research related to subsurface contamination will be directed at improved environmental measurement technology and at physical, chemical, and biological interactions that control the transport of mixed contaminants. Research on biological remediation techniques using microorganisms found at depths of up to 2000 feet also will be emphasized.

Another very important research area in FY 1991 relates to possible global change from the increase of greenhouse gases and, especially, from carbon dioxide. The Department's Carbon Dioxide Research program, for which the FY

1991 budget request is $65.9 million, is the principal DOE activity in the U.S. Global Change Research Program organized by the Committee on Earth Sciences (CES) of the Office of Science and Technology Policy. The Secretary of Energy has identified global climate change as an important environmental consideration in the development of the National Energy Strategy. Consequently, DOE has launched a major research initiative to provide the scientific underpinning for prediction of global and regional climate change. A principal component of this initiative is an experimental program to quantify cloud formation processes. Using measurement and modeling techniques, researchers will examine the roles of clouds and their effect on the sun's naturally occurring radiation (i.e., the radiative effect) in climate change. The information gained from such research is essential for improved prediction. A second component is an effective integration of advanced computer hardware and software with the next-generation climate models in order to accelerate computer operations by a factor of 10,000 within the next ten years.

The program will continue to seek multidisciplinary input from the scientific community to gain a broad perspective. Climate change research activities throughout the Department are being coordinated by the Office of Energy Research, with interagency coordination being implemented through the CES. International activities are coordinated through such organizations as the Intergovernmental Panel on Climate Change.

The Medical Applications activity, with an FY 1991 budget request of $37.0 million, carries out a wide range of projects aimed at the beneficial medical

application of energy-related technologies. Over the years, the Department's medical research has provided information that has led to the widespread use of nuclear technology in modern clinical and laboratory medicine, opening avenues of diagnosis and treatment that otherwise would not have been available. Research in FY 1991 will focus on non-invasive diagnosis and treatment techniques, development of improved instrumentation, and improved methods for studying brain and heart function and for diagnosing abnormalities in these organs. For instance, studies using Positron Emission Tomography, commonly known as PET scans, have identified areas in the brain that are most affected by alcohol and cocaine. These studies provide information about the neurochemical mechanisms through which these substances act on the brain. Further studies will be directed to determining whether it is possible to recover from the damage that is produced. Another use of PET scans is to locate the lesions in the brain that cause epileptic seizures. This information is useful as a guide to surgical treatment. PET scans can also help to determine which patients will benefit from coronary by-pass surgery.

The FY 1991 request for Program Direction is $5.8 million. These funds are required to pay for the personnel costs of 65 full-time equivalent (FTE) staff to direct, manage, and support BER's multidisciplinary research efforts. The FY 1991 request for Capital Equipment is $11.6 million. This request supports replacement of deteriorated and obsolete equipment at the laboratories as well as acquisition of new, state-of-the-art equipment, particularly for human genome and carbon dioxide research.

The request for Construction in FY 1991 is $3.5 million. The General Plant Projects that fall under this request are necessary to keep the general plant of the laboratories (e.g., buildings, roads, and utilities) in good operating condition.

Now let me turn to the several ER programs that are related to my statutory responsibilities to advise the Secretary on DOE's research and development programs, on the non-weapons multiprogram laboratories, and on the education and training of scientists and engineers.

ENERGY RESEARCH ANALYSES

The Energy Research Analyses (ERA) program carries out technical assessments and research analyses that cover all aspects of the Department's civilian R&D programs. These in-depth reviews provide information on the quality of the research and its impact, as well as identify opportunities for future research. In 1989, reviews of the Photovoltaics, Flue Gas Cleanup, and Chemical Toxicology programs were completed. A major research needs assessment on coal liquefaction was also completed and will provide valuable information to help guide the program for the next several years.

In addition to carrying out technical assessments and analyses, the ERA program plays a key role in coordinating the Department's involvement in acid rain research. Specifically, the program provides funds under the National Acid Precipitation Assessment Program (NAPAP) for summarizing the state of the science in acid rain research and producing assessment reports useful to

policymakers. ERA's emphasis on technical peer reviews has made a major contribution to NAPAP's final report which is being prepared in FY 1990 and will be completed in FY 1991.

The FY 1991 budget request of $3.7 million will provide funding for peer reviews and technical assessments of programs in the Office of Energy Research, as well as programs under the Assistant Secretary for Fossil Energy and the Assistant Secretary for Conservation and Renewable Energy. In addition, funds will be provided to assess responses to the final NAPAP report and to continue to monitor interagency research results related to clean air issues.

UNIVERSITY AND SCIENCE EDUCATION

There is a growing consensus that one of the most serious problems facing the Nation over the next ten years is the declining number of young Americans, including women and minorities, interested in pursuing careers in science and engineering. Those who are interested often receive inadequate preparation for such careers. This crisis in science education has serious implications for the Nation's continued international economic and technological competitiveness. It also has implications for the Department's ability to carry out its science, energy, and defense R&D missions.

The Department is both a user and a patron of a large fraction of the Nation's scientists and engineers. To meet the challenges facing the Department today and in the future, we have to depend on the scientific creativity and technical skills of our workforce. DOE is uniquely positioned to provide

major assistance to the national effort to strengthen science and engineering education. The Department's long tradition of support for science education continues today. Several of our laboratories have been designated as Science Education Centers and are carrying out comprehensive science education programs. Our efforts complement those of the National Science Foundation, the Department of Education, and other Federal agencies, state and local governments, and the education community by providing students and their teachers with "hands on" experiences in ongoing, cutting-edge scientific and technical research.

Secretary Watkins has made support for science education a personal and Departmental goal. He was an active participant in the President's Charlottesville Summit Conference. Last October, shortly after the Conference, the Secretary and Nobel Laureate Glenn Seaborg cohosted a Math/Science Education Action Conference in Berkeley, California. Over 200 senior representatives from Federal agencies, Congress, education associations, States, industry, and the National Laboratories met in working groups to formulate the outline of an action plan to improve science education dramatically by the year 2007.

The FY 1991 budget request of $29.7 million for University and Science Education reflects, in part, the Secretary's and the Department's commitment. (Table 12) This request will continue the existing base programs, including undergraduate student summer and semester research programs as well as faculty and graduate student research activities. The FY 1991 request will also include new activities responsive to the Secretary's Math/Science Education

Table 12
Energy Supply R&D
University and Science Education
Budget Authority
($ in millions)

	FY 1989	FY 1990	FY 1991 Request
Operating Expenses			
Laboratory Cooperative Science Centers	$ 11.2	$ 11.9	$ 18.2
University Programs	6.8	6.8	1.9
University Reactor Fuel Assistance	2.0	4.0	7.2
R&D Laboratory Technology Transfer	1.4	2.2	2.4
Total University and Science Education	$ 21.4	$ 24.9	$ 29.7

Action Conference and to recent reports including the Energy Research Advisory Board's report on the Department's potential role in science education; the Interagency Task Force on Women, Minorities, and the Handicapped in Science and Technology report, "Changing America: The New Face of Science and Engineering;" and the National Research Council report, "Everybody Counts."

Among the new initiatives in FY 1991 are inner city/rural partnerships designed to revitalize math and science education in targeted school districts. Another initiative will be the establishment of a precollege mathematics science education program at the DOE laboratories. There will also be: a traveling museum-based science education program consisting of exhibits on major energy-related scientific programs; increased precollege science teacher research appointments and minority high school student appointments to encourage more students to stay in the math/science pipeline; and emphasis on reaching students at a younger age, especially women and minorities, through the Prefreshman Engineering Program.

Two collaborative initiatives have already been announced that respond to this new emphasis on science education. The Chicago "Science Explorers Program" is a collaboration among ANL, FermiLab, the Chicago Public Schools, and a group of Chicago institutions involved in science education. The program is aimed at stimulating a high level of interest in science and math in 10,000 Chicago students. Another initiative is a cooperative program in math and science education between DOE facilities in Oak Ridge, Tennessee and the University of Tennessee. It will provide opportunities to college students who want to teach math or science, as well as to scientists and engineers or retirees who

want to teach. A third initiative will begin this Spring and will involve the Pacific Northwest Laboratory in a collaborative science education program impacting the Hispanic and Native American populations, with another initiative expected in New Mexico using DOE facilities there.

The FY 1991 University and Science Education program will continue to provide support for refueling and related activities for university nuclear research and training reactors.

The R&D Laboratory Technology Transfer program, which supports DOE laboratory efforts to spin off new technology to U.S. industry and universities, will also continue in FY 1991. Under this program, scientists from large and small industries work on assignment at DOE laboratories with laboratory scientists. This is a valuable interaction because new skills and technology are transferred on a timely basis through cost-shared arrangements. The value of these interactions in terms of technology transfer is illustrated by the fact that, in the last five years, DOE laboratories have won over 25% of the R&D 100 awards given annually by R&D Magazine for the best new products, processes, and materials.

UNIVERSITY RESEARCH INSTRUMENTATION

The University Research Instrumentation (URI) program provides another way to strengthen the Nation's science and education infrastructure. This program helps universities acquire the state-of-the-art instrumentation that is needed to conduct long-range research on energy problems. In the process, the

program provides graduate students with hands-on experience in the use of this sophisticated research equipment. This annual, competitive program involves substantial cost sharing from the institution receiving the equipment.

The FY 1991 request of $4.9 million will assist universities in purchasing instruments that cost over $100,000 each and that will be used by a number of researchers, including students. In selecting approximately 20 proposals to be funded, special emphasis will continue to be placed on innovative instrumentation needed to carry out research on advanced topics in energy research.

MULTIPROGRAM ENERGY LABORATORIES--FACILITIES SUPPORT

The objective of the Multiprogram Energy Laboratories--Facilities Support program (MEL-FS) is to maintain the capabilities of the five national laboratories overseen by the Office of Energy Research to carry out their missions in a safe, healthy, and cost-effective manner. To accomplish this, the program supports activities that help counter problems of aging and obsolescence of facilities as well as safety and health inadequacies.

The FY 1991 Construction request of $23.7 million will support continuation of all ongoing projects. There are no new starts included in the request.

ADVISORY AND OVERSIGHT PROGRAM DIRECTION AND POLICY AND MANAGEMENT

The FY 1991 budget request for Advisory and Oversight Program Direction is $4.3 million. The FY 1991 request will provide the staffing resources required by the Director of Energy Research to carry out his responsibilities under legislation (P.L. 95-91) and those assigned or delegated by the Secretary in areas beyond the scope of other ongoing Energy Research programs. These funds are required to provide for the salaries, benefits, travel, and other expenses associated with 50 full-time equivalent employees.

The FY 1991 request for Policy and Management is $0.9 million. These funds are required to provide for the salaries and related expenses associated with 8 full-time equivalent employees in the Office of the Director of Energy Research.

That concludes my statement. I would be happy to answer questions.

THURSDAY, MARCH 8, 1990.

NUCLEAR FISSION; URANIUM SUPPLY AND ENRICHMENT ACTIVITIES; AND NUCLEAR WASTE FUND

WITNESSES

WILLIAM H. YOUNG, ASSISTANT SECRETARY FOR NUCLEAR ENERGY

SAMUEL ROUSSO, ACTING DIRECTOR, OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

Mr. BEVILL. The subcommittee will come to order.

Mr. Young and Mr. Rousso, we are pleased to have each of you with us this morning. Your prepared statements will be made part of the record. You may summarize or proceed as you wish.

The Chair recognizes you at this time, Bill.

OPENING STATEMENT

Mr. YOUNG. Thank you. It is a privilege to appear before this committee. In the interest of time, I will cover only the several highlights of the many programs under the Office of Nuclear Energy. The substantive details are in the written testimony.

As you are aware, the Department, at the request of the President, is developing a comprehensive National Energy Strategy in which nuclear energy options will receive full and balanced consideration. Through public hearings and written testimony, the Department is considering the regulatory and technical obstacles to greater reliance on nuclear power. A major element of the Department's strategy will be to forge an open and informed national consensus on the obstacles to, and actions needed, to provide an energy future marked by ample, competitively priced, environmentally sensitive supplies of energy.

ADVANCED NUCLEAR TECHNOLOGIES

The Office of Nuclear Energy has an integrated plan related to the development of advanced nuclear technologies. We will review the content of this plan as the National Energy Strategy evolves during the remainder of calendar year 1990. The surest and most economical path to revitalization of the nuclear option is application of the three decades of successful industry experience with light water reactor technology to produce advanced and even safer new plants. Advanced reactor systems offer the potential for significant improvements in safety, economics, and waste management.

The most promising nuclear plant design for commercial application in the near term is the Advanced Light Water Reactor. The Department's design and certification program is expected to result in at least one, approximately 1200 megawatts, Advanced Light Water Reactor design being certified by 1991. We are also support-

ing a program to develop and certify simplified mid-size ALWRs. We have selected the Westinghouse AP600 and the General Electric SBWR designs for further development and certification on a cost-shared basis.

The Department is supporting two other advanced reactor designs which should be certified by early in the next century. The first design is the Modular High Temperature Gas-Cooled Reactor, for which a conceptual design has been completed. This reactor will provide the advantage of further utilization of passive safety features and the ability to be used in process heat applications as well as electrical generation.

The second design is a Liquid Metal Reactor, for which a conceptual design is being developed. This reactor and its associated fuel cycle will assist in resource conservation.

Mr. BEVILL. Mr. Young, if I may interrupt you momentarily. We have a motion requiring a quorum of this committee regarding next week's hearings.

At this time, I recognize Mr. Myers.

Mr. MYERS. This is a housekeeping item.

Mr. Chairman, because the Subcommittee on Energy and Water Development will be dealing next week with highly sensitive and classified material, I move that the sessions on March 12th, 13th, and 14th be held in executive session.

Mr. BEVILL. You have heard the motion. The clerk will call the roll.

The CLERK. Mr. Bevill?

Mr. BEVILL. Aye.

The CLERK. Mrs. Boggs?

Mrs. BOGGS. Aye.

The CLERK. Mr. Fazio?

Mr. FAZIO. Aye.

The CLERK. Mr. Watkins?

[No response.]

The CLERK. Mr. Thomas?

Mr. THOMAS. Aye.

The CLERK. Mr. Chapman?

Mr. CHAPMAN. Aye.

The CLERK. Mr. Whitten?

[No response.]

The CLERK. Mr. Myers?

Mr. MYERS. Aye.

The CLERK. Mrs. Smith?

Mrs. SMITH. Aye.

The CLERK. Mr. Pursell?

[No response.]

The CLERK. Mr. Conte?

[No response.]

Mr. BEVILL. Thank you.

Mr. MYERS. Mr. Chairman, I move it be held open to the end of this session so other members who do come in may vote.

Mr. BEVILL. Without objection, the motion is agreed to.

You may proceed.

Mr. YOUNG. Yes, sir. The Liquid Metal Reactor and its associated fuel cycle will assist in resource conservation and offer the possibil-

ity of easing a national nuclear waste disposal problem by incinerating long-lived actinides, permitting the biological risk of high-level waste to be reduced to a level comparable to that of natural uranium ore within a few hundred years.

NUCLEAR SAFETY POLICY

In accord with Admiral Watkins' reorganization of Departmental responsibilities, the Office of Nuclear Energy has been assigned responsibility for developing and coordinating nuclear safety policy for all Departmental nuclear reactor and non-reactor nuclear facilities. The Office of Nuclear Energy assumed that responsibility on January 31, 1990.

SPACE NUCLEAR POWER SYSTEMS

In addition to civilian nuclear power, the Office of Nuclear Energy also supports the Space and Defense Power Systems Program. We have solidified the commitment of DOE, DOD, and NASA to develop the SP-100 space reactor through an amendment signed last October to the existing agreement. This space nuclear technology will provide power to the user community. Also we will continue RTG development and production for NASA's CRAF and Cassini missions scheduled for launch in 1995 and 1996. The activities, which require the development and fabricating of power system hardware and construction of necessary reactor facilities to conduct tests, require a certain level of funding so that they may be conducted safely while meeting mission requirements and schedules.

URANIUM ENRICHMENT

Another important program in the Office of Nuclear Energy is our uranium enrichment enterprise. Today, we have approximately 50 percent of the commercial world enrichment market. Although this makes us the largest single supplier, we face increasing competition and must constantly innovate to retain our market share. To compete more effectively, we believe that it is necessary to restructure the uranium enrichment enterprise in the United States, and have proposed legislation to create a Government-owned enrichment corporation. In the meantime, we are taking steps to improve the efficiency of the enterprise and concentrate on environmental responsibilities. During fiscal year 1991, our efforts will focus on these two important areas.

In uranium enrichment, safe and environmentally acceptable plant operations in full compliance with all laws and regulations are priority considerations. In Fiscal Year 1991, the enrichment enterprise plans to spend more than $90 million to upgrade and bring active sites into compliance with environmental requirements. This is equivalent to approximately 30 percent of the enterprise's non-power operating budget. In the long run, we believe that the best hope for major cost reductions is the successful deployment of the AVLIS technology. Along with the $154.5 million fiscal year 1991 budget request, the Department submitted to Congress an AVLIS Demonstration and Deployment Plan committing to near full-scale technology demonstration in 1992, along with the activities neces-

sary to support the eventual establishment of a production facility. An AVLIS plant deployment decision will be made in November 1992.

FAST FLUX TEST FACILITY

Finally, with regard to the Fast Flux Test Facility, the Department could not justify the production of Plutonium 238 at FFTF given the advantages of lower capital and operating costs at our existing Savannah River facilities. The Department sought other uses for the FFTF, but no significant mission that would justify the annual cost of FFTF operation was identified. Therefore, it was with regret that we found it necessary to conclude that FFTF should be shut down.

PLUTONIUM 238 PRODUCTION

Let me make a point related to the Plutonium 238 mission support. Some of the Savannah River facilities are needed immediately for Plutonium 238 scrap recovery and blending and to process and supply Neptunium 237 for PU-238 production, regardless of the site selected. A total of $12.2 million is needed this fiscal year for PU-238 inventory processing and preproduction tasks. In light of the disapproval of our prior request of this $12.2 million, we are examining ways to reprogram funds from other Departmental activities to allow us to proceed, and we would obviously come back to you on any proposals.

The highest priority is operating a facility called the HB Line, in which we will process existing inventory and scrap material into usable product. Next is the refurbishment of the Neptunium 237 billet line, an early stage in the process of fabricating target assemblies to be irradiated in a reactor. The billet line has not been operated for several years and must be returned to an operational condition. We also need to install new equipment in the reprocessing building to recover PU-238.

If these activities do not proceed promptly, the NASA CRAF and Cassini missions will be delayed.

Thank you very much for the opportunity to speak to you. I will be happy to answer any questions you might have.

[The prepared statement of Mr. Young appears at the end of the hearing record.]

Mr. BEVILL. Thank you for your statement. Mr. Rousso, we will hear from you next.

CIVILIAN RADIOACTIVE WASTE MANAGEMENT

Mr. ROUSSO. Thank you, Mr. Chairman and members of the subcommittee. I appreciate the opportunity to appear today to discuss the Department's Fiscal Year 1991 budget request for the Civilian Radioactive Waste Management Program.

A number of major events have occurred in the past year which have dramatically affected the Waste Management Program and will shape its course during the coming years. The focus of this course will be to initiate scientific investigations at the Yucca Mountain site to determine the site's suitability or non-suitability as a repository. By way of introduction, I would like to review some

of these events quickly before I present the budget for Fiscal Year 1991.

The Secretary initiated a comprehensive review of the program in an effort to address concerns noted by this committee, the Congress, and utility representatives related to the program's schedule slips, problems in management structure, and a lack of integrated contractor efforts. The results of that review were summarized in the Secretary's Report to the Congress last November. The Secretary concluded that the program and supporting activities have a sound scientific basis but could not be executed effectively under the then existing management initiatives and structure. Several important actions have been taken to establish an improved management structure. The Secretary selected and the President has nominated to the Congress the selection of Doctor John Bartlett to be the permanent director for the Civilian Waste Program. His confirmation hearing before the Senate Energy and Natural Resources Committee was held on February 5th. The committee approved his nomination and he is now awaiting full confirmation by the Senate.

In addition, direct-line reporting of the Yucca Mountain Project to the DOE Headquarters office has been implemented.

The Secretary also reevaluated the overall program schedule and established new milestones that reflect a much more realistic assessment of where we are. Last November, new schedules for three program phases were made available for public review and comment: a near-term schedule, which sets the course for the program's activities over the next 15 months; a longer-term schedule out through license application in the year 2001; and a total program schedule to the year 2010 for repository operation.

I have provided to each of the committee members a copy of those three schedules. I will say that on the near term schedule there are some 40 milestones in the first 6 months that are colored in green. They are all completed. Regarding actions completed in the last three months since the charts were issued, there were 30 milestones and all of those are completed.

In the area of scientific investigation of Yucca Mountain, we have attempted to carry out the 1987 law to characterize the site. However, actions taken by the State of Nevada have prevented us from carrying out the direction of Congress and have added delays to the program. It has taken, for example, two years for the State to act on a 5-page air permit. Last December, the State decided to return all permit applications unprocessed and filed suit against the DOE stating that they felt they had disqualified the site; that they had vetoed the site selection as a potential repository. We, in turn, filed suit on January 25 through the Department of Justice asking that the State act quickly on the permits and disavow their position that the State has been disqualified.

MONITORED RETRIEVABLE STORAGE

Regarding timely acceptance of waste, we are continuing to develop an MRS strategy and the strategy is based on seeking volunteers to host an MRS and developing the necessary institutional processes. We believe that we can have an early MRS facility in a

simple form with a target date of 1998. If we are to establish public credibility in our Nation's ability to safely manage and dispose of its nuclear waste, we must move forward with this program.

BUDGET OVERVIEW

Turning to the budget overview very quickly; you have our full budget request before you. In Fiscal Year 1991 our request for the total program for the Nuclear Waste Fund is $292.8 million. We are also requesting from this committee $.7 million from the Energy Supply Research and Development account for the Civilian Radioactive Waste R&D Program, which supports generic research.

Our new schedule, which is laid out in the November submission, seeks to begin new surface based work at the Yucca Mountain site in Fiscal Year 1991. I should note that we also have both non-surface disturbing work and surface based work. The non-surface disturbing work does not require the permits and there is a large broad-based body of activity that includes monitoring stations, hydrologic studies, seismic studies, volcanic processes and events, and laboratory work, all of which is going on and can go on in the absence of permits.

We are also doing design work on the Exploratory Shaft, alternative studies. We will be doing Title II design in Fiscal Year 1991 on the Exploratory Shaft.

In the Monitored Retrievable Storage area, we have an increased focus in activity. We would hope that a volunteer site would be recognized. We are seeking to follow that process rather than a DOE siting process, where we go through a selection criteria. We would expect to work with a Negotiator, whom we understand is proceeding through the White House process, and expect to go forward with a simple storage-only phase I MRS which could be available in 1998.

In the area of transportation and systems integration, we are proceeding with cask designs. We have reduced that program due to funding limitations and the stretch out of the program. We are currently looking at one legal weight truck cask design and one rail/barge cask design with two follow-up possibilities.

The requested funding for Program Management and Technical Support is for 250 Full Time Equivalents and is necessary for providing outreach and public involvement activities—our activities to support the Nuclear Waste Technical Review Board, cooperative agreements with the National Academy of Sciences, working with the National Congress of American Indians, and other such groups. It also supports the licensing support system.

That completes my oral statement, Mr. Chairman. I would be pleased to respond to any questions of the committee members.

[The prepared statement of Mr. Rousso appears at the end of the hearing record.]

BARRIERS TO NUCLEAR ENERGY

Mr. BEVILL. All right. Mr. Young, in your opinion what are the hurdles that must be overcome before nuclear energy will again become a preferred energy option?

Mr. YOUNG. The first is to establish a more reliable and certain licensing regime. The NRC has passed a rule which provides for standard certified designs of pre-approved sites and streamlined procedures for licensing and holding hearings for a plant. We believe that there are some improvements that still might be made to that rule through legislation that might improve upon the emergency planning aspects and the way they are treated; and improve upon the treatment of the second hearing as envisioned in the process.

Second, I believe that based upon that licensing regime, the Nation needs to bring forward standardized nuclear plant designs that would be available for ordering by potential owners who would be able to utilize them in this streamlined licensing process. The Department is cost-sharing with the utility industry and vendors the development, first of an improved version of the present reactors, and second, a version of a 600 megawatt plant. The bigger plant's certification would start in 1991 by the NRC. For the smaller plants, the certification is scheduled to be completed by 1995. In other words, by 1995 the utilities or other owners could have a design to pick from in a revised licensing regime.

We also have included in the Fiscal Year 1991 budget $3 million for the commencement of activities leading to securing an early site permit. Basically, to use the streamlined licensing procedures, you must have not only a certified design to be ordered, but a site that has been predetermined to be acceptable. We have put a small amount of money into this to contemplate a fairly low cost process to encourage potential owners, utility companies, to start to get sites approved to be available for nuclear plants when they might be ordered. We have a process, hopefully, to start being able to do that in fiscal year 1991.

I think another aspect that needs to be addressed, obviously, is the nuclear waste question. We believe that Admiral Watkins' plan is a good start at resolving these features. It is very clear that progress needs to be made on the plan. We can see that by the mid-1990s, if the Department can make the progress it plans to make, there would be much more certainty related to both the repository and its use, and to the location and environmental clearance of the Monitored Retrievable Storage facility such that a potential nuclear plant owner could have a much better feel by the mid-1990s that there is a solution underway for nuclear waste storage.

I think, obviously, things need to be done with the State regulatory commissions to improve the prospect for economic certainty for potential owners to know that they would be able to have their investment recouped at the completion of the process. The Department plans an effort to support improved procedures with these commissions. It is not so much a money thing, it is an institutional activity on our part to encourage commissions to streamline their procedures and permit investment recovery.

Last, with respect to the public, we are very encouraged by a couple of polls that were taken in 1989. One poll indicated that about 81 percent of the American public recognizes that nuclear energy will be an important element of our energy future. The other poll, which was addressed to people in a given locality, asked whether they would be willing to have a nuclear plant sited in

their area to provide electricity. That poll showed that while there were 15 to 20 percent on each side, pro or anti, that 59 percent of the public would reserve judgment and would be open to education and discussion. So we view that one of the things the Department would do would be to look forward to making sure that the right kinds of information are getting out to educate the public, to provide facts to the public as to the risks and the benefits of nuclear energy.

Those, I think, are the obstacles I would address and what we are doing about them.

Mr. BEVILL. You may want to expand on that in the record.

Mr. YOUNG. Yes, sir.

URANIUM ENRICHMENT CORPORATION BILL

Mr. BEVILL. I am delighted to hear that the NRC is now coming out with some regulations on standardization. This panel has been urging that for over 12 years and has been promised that for even longer. We were being told that NRC didn't have the authority. I remember asking one question, "You have the authority to license, don't you?" If you have the authority to license, that's all you need, really. Apparently, that is what they are doing now. I am glad after a few years they decided they had the authority to do it.

The President's budget assumes the submission of legislation to provide for the privatization of the uranium enrichment enterprise. Please describe the legislation, including the cost and benefits.

Mr. YOUNG. The Administration has submitted a bill, H.R. 2480, that envisions a Government corporation with a board of directors, appointed by the President and approved by the Congress, and for the board to choose a president. It provides that that Government-owned corporation would be run like a private business. The management would be selected by the President and the board from the private sector. The initial capitalization of the corporation would be from existing funds within the Department's surpluses that would permit them to get started. We would envision the corporation operating for a period of five years, ultimately envisioning a transfer to the private sector, but that transfer would depend upon demonstrating that the corporation can make money. We would estimate that a billion dollars in net income could be generated over those five years.

It also provides that the plants in effect at that time ultimately would be licensed by the NRC. There also is a plan covering five years of both developing the regulations and carrying out the actions with the NRC to have a privatized plant that would be licensed.

The initial debt that we would establish for the corporation would be $364 million, which would be paid back. We also would envision the corporation paying off from revenues approximately half of our estimated cost of decontamination and decommissioning of, for example, the diffusion plants, once they are no longer used. We estimate that total to be $3 billion and we have taken the position that the Government corporation and ultimately the private sector should pay half of that through contributions of $50 million a year.

REPOSITORY LITIGATION

Mr. BEVILL. Describe the status of the litigation against the State of Nevada to obtain licensing permits.

Mr. YOUNG. Sir, that would be for Mr. Rousso.

Mr. ROUSSO. If I may respond, Mr. Chairman. The status is that the State of Nevada, as I mentioned quickly in my opening statement, has filed suit against the DOE. Those arguments are being heard in the Ninth U.S. Circuit Court of Appeals. I believe that the State is filing in April, and we get a chance to respond at the end of May. I believe early June is a final rebuttal from the State. The State has also asked that their case be heard first in that Circuit Court. We have filed in the U.S. District Court in Nevada to obtain the permits. The State of Nevada asked to stay the action in the District Court while the issue is heard first in the Appeals Court. We are against this and we will be filing our motion in opposition to the stay shortly. I would expect that we would have some initial indication by early summer as to how this case is progressing.

Mr. BEVILL. All right. If you can add any more to that in the record, it will be helpful.

Mr. ROUSSO. I would be pleased to keep the committee apprised of the situation.

URANIUM ENRICHMENT CORPORATION BILL

Mr. YOUNG. Mr. Chairman, may I just add a couple more points on uranium enrichment?

Mr. BEVILL. All right.

Mr. YOUNG. We believe that the Government corporation we're proposing, in addition to the features I described, would be capable of operating more efficiently than within a Government organization. It would have more flexibility in management, financing, and in pricing to be able to operate more efficiently, and compete in what is becoming a much more competitive market.

The other point I would like to make is that in support of the Department's position of the legislation, we have contracted with the investment banking firm of Smith Barney to perform an independent assessment market viability of the Government-owned corporation we're proposing. This will be a completely independent study, that will arrive at its own conclusions, and it should be available in the middle of May to add additional information for the Congress for consideration of our legislation.

Mr. BEVILL. The Chair recognizes Mr. Myers.

Mr. MYERS. Thank you, Mr. Chairman.

Mr. Young, I think this is your first appearance formally before the committee. Welcome. Of course, you are in the company there of an old pro, Mr. Rousso.

Mr. YOUNG. Yes, sir. Thank you.

INTEGRAL FAST REACTOR

Mr. MYERS. In the discussion the other day with Secretary Watkins, we talked about the advanced technology and recyclable fissionable productions, the by-products. Of course, there has been a lot of discussion about that. You spoke today about the FFTF as a possibility.

I understand now the decision has been made to go to Idaho for the IFR.

Mr. YOUNG. Yes, sir. Several years ago, in 1986.

Mr. MYERS. Yes. How much money is in the budget this year for the IFR?

Mr. YOUNG. As I recall, it is something like $17 million.

Mr. MYERS. It is all facility funding, is that right? There is no operation in this budget this year, is that correct? It is all capital?

Mr. YOUNG. My understanding is that there are operating funds, yes. One of the reasons the money is down from last year is that last year we spent money getting the facilities ready to operate and this year they would be operating.

Mr. MYERS. We are going to use the reactor that is already there.

Mr. YOUNG. We are using a reactor that is already there. We have been modifying the fuel cycle facilities. The IFR is a process that reprocesses spent fuel from the reactor, and puts new fuel back into the reactor, all in one location.

Mr. MYERS. Kind of like the breeder then. Isn't it similar to the process of the breeder?

Mr. YOUNG. Yes, sir, but there is one important distinction. This process does not separate free plutonium. The plutonium that's generated is in with other high radioactive actinide materials such that the diversion resistance to this is entirely different than a plutonium recycle regime, which might be associated with breeder reactors.

Mr. MYERS. When will that be in production?

Mr. YOUNG. The demonstration of the Integral Fast Reactor is due to be completed by fiscal year 1995 at Idaho.

Mr. MYERS. Well, what's included for operation then? What are you spending the money on? If you are not producing, what are you operating?

Mr. YOUNG. We are operating a reactor and a fuel cycle facility adjoining it to prove that we can manufacture fuel of the metal fuel type, put it into a fast reactor, run it to a certain burnup, take the fuel out, reprocess it in its new pyrometallurgical process, take the desired elements out of that process, fabricate new fuel, and put it back in the reactor and burn that up. It is a whole sequence of events of using the reactor and reprocessing in that cycle that we want to demonstrate.

Mr. MYERS. The existing reactor that you are modifying now will never be actually used for production. It is just to prove the system will work. You are actually going to build adjacent to that the new reactor that will be the producing reactor.

Mr. YOUNG. I am not sure whether it would be adjacent to—yes, sir. The next generation of liquid metal reactors would be what we call the "PRISM" design, which is being developed. We would envision building a prototype of that design at some location.

Mr. MYERS. Are you looking for a location?

Mr. YOUNG. Not yet.

LIQUID METAL REACTORS

Mr. MYERS. Back to ground zero again. Okay. The Department has shown an increased interest in recent years in liquid metal.

Yet, as I looked at your budget, you are going to request less money for liquid metal research. Can you explain your reason for this?

Mr. YOUNG. Yes, sir. It is for two reasons. First, the one I mentioned earlier, that is that in the expenditures for facilities, we had a larger amount in Fiscal Year 1990 than we are proposing for 1991. The reason it is less is that we finished the more expensive work of preparing the facilities.

The second reason, however, is that we have an integrated plan for bringing technologies along potentially to be used by the country. The first technology in line is the Advanced Light Water Reactor, with our goal of having it available to be used by the Nation no later than the mid-1990s. The second technology in line is the Modular High Temperature Gas-Cooled Reactor, where we envision that being available right around the turn of the century or shortly thereafter. And the third technology in line, if you will, is the Liquid Metal Reactor, which would come in the early part of the next century. The amount of funding that we assign to the Liquid Metal Reactor recognizes the time frame in which it potentially would be used and the interest so far that exists within the utility industry and the Nation in using it.

HIGH TEMPERATURE GAS REACTOR

Mr. MYERS. The Department through the years has shown at times an interest in the High Temperature Gas Cooled Reactor, and then some years it has been out of the budget entirely. What can you tell us about the future for the HTGR?

Mr. YOUNG. We look forward to having the HTGR available to potentially be ordered commercially early in the next century. For Fiscal Year 1991, we have a budget which I would say is the full amount of money needed to continue with that technology in an expeditious manner. The amount requested is up slightly because we are moving from conceptual design into preliminary design. We have also worked closely with the new production reactor people. We actually have some $29 million of activities in their budget which are common to the HTGR. So we are applying funds to the HTGR to bring it along as quickly as we can to be available as an option.

Mr. MYERS. Is there any utility interest at this point, and are they providing any of the funding for continued research and development of an HTGR?

Mr. YOUNG. There is a group of utilities under Gas Cooled Reactor Associates that is looking for ways in which they might propose to come in and build a demonstration plant, but that is the way in which they would contribute is through the potential demonstration plant.

They are also putting about $2 to $3 million a year into the budget.

Mr. MYERS. At what phase of the process are they providing this money?

Mr. YOUNG. They are putting it in now.

Mr. MYERS. In research alone?

Mr. YOUNG. Yes, sir. In design.

Mr. MYERS. But they are still just kicking tires. They aren't really buying yet?

Mr. YOUNG. They are looking actively at a way in which they might put together a viable project to build a demonstration plant. So far they are putting a few million a year in support of a budget of ours, which is about $25 million.

FAST FLUX TEST REACTOR

Mr. MYERS. We know, of course, that the Department has asked for a reprogramming to shut down FFTF after years of operation. This committee has experience with the Department, where it gets real hot on something and next year blows real cold on it. As you know, Congress hasn't gone along with that request at this time. Is the Department looking for another role for FFTF? And, what would be the adjustment needed in the FY 1991 budget if we did not go along with the reprogramming to close down FFTF?

Mr. YOUNG. First of all, the Department has examined many, many possible roles for the FFTF. The FFTF originally was to be the prototype for the Liquid Metal Reactor Program that supported Clinch River, Clinch River obviously died in 1983.

Mr. MYERS. It didn't die, it was killed.

Mr. YOUNG. It was killed. Yes, you are absolutely right.

Mr. MYERS. There's a difference.

Mr. YOUNG. Yes, sir.

Mr. BEVILL. By the way, John, you said that happened during the Carter Administration. That's true, but that was a Republican Senate that killed it. Excuse me, go ahead.

Mr. MYERS. Upon request though, of course.

Mr. YOUNG. In 1986, the decision was made to go to a metal fuel system which had been the basis of the Liquid Metal Reactor program. The decision was made at that time that the metal fuel system and the integrated Fast Reactor concept could most economically and best be done at EBR-II in Idaho. Over the past couple of years there have been looks at possible missions for FFTF, many possible missions. We have looked at the possible extension of some Japanese experiments related to liquid metal. Our input was that would involve only a few million a year.

Our basic situation is that it costs $100 to $115 million a year to run FFTF.

Mr. MYERS. How much?

Mr. YOUNG. $100 to $115 million per year. The only revenue that we are receiving currently to offset that $115 million is $1 million per year from a set of fusion experiments, so we basically are paying in the nuclear energy budget the entire cost of running that reactor. We have looked at other missions and what they might be able to contribute to defray the expense of operation. What I am saying is that the Japanese in the LMR area might have a few million worth of work that might go on, but only that level. We have checked the NPR program for research and found nothing there. One of the main hopes that we were looking at was the possible assignment to the FFTF of the mission of doing the production of plutonium 238 to satisfy NASA and Navy missions. We found that the facts there proved to be overwhelming in terms of doing that

mission at Savannah River from several standpoints. One, Savannah River is the only operation where we could meet the mission timing needs.

Mr. MYERS. When is that going to start?

Mr. YOUNG. We would expect plutonium out of Savannah River in 1992. Basically, Savannah River has a tritium production mission. There is an almost insignificant cost, along with producing tritium, to produce PU-238. So that when you have a situation with FFTF where there are large operating costs and basically minimal additional operating costs at Savannah River, the cost-benefit, even when you consider the shutdown cost of FFTF, was overwhelming. It was more than $500 million over five years.

ACTINIDE RECYCLE AT FFTF

We have also examined other possible missions. We took a very hard look at what we call "actinide recycle," at taking the Defense waste that comes out of Hanford, Rocky Flats, and other Defense facilities and burning up the long-lived elements of so-call actinides in a fast reactor so as not to have to bury them. We looked at FFTF as the vehicle to perform that mission for Defense waste. What we found was that by the time you design a reprocessing system, operate a reprocessing system, and produce isotopes that you want to burn up in a reactor like FFTF, it is out into the late 1990s. We process some weapons grade plutonium ahead, but we don't want to burn them up. So, we concluded it would be the late 1990s before we would have the ability to use the reactor for that nature.

Mr. MYERS. Well, at this point I guess we are still wondering if there could be a mission for FFTF.

I'll tell you what brings this on. You speak about uranium enrichment and creating a Government corporation. This committee has been down that uranium enrichment path. First, we had gaseous diffusion, then we had the upgrade of the gaseous diffusion plants, on which we spent several hundred million dollars. We just got that finished when we decided we had a better process, we were going to build the gas centrifuge. We built several prototype centrifuges. Finally, in Portsmouth, Ohio, we started building a plant, only to find out that, "Oh, we have changed our minds." Now, we are going to build AVLIS. What's next? We just have been burned so many times.

The Chairman and I were talking about Clinch River yesterday Tom, I didn't mean to put a political cast on it. I said it lightly. I think President Carter was wrong, but I think he really just presided over the post mortem. The damage was done before Carter really got here. It was poor management and lack of concern by Congress and the thing was killed. I think it was a big mistake. It would have provided a balance in using up all the waste, it would have been a balance this country still needs. As we understand it, it would help provide answers to some of our waste problems today if we had a Fast Breeder Reactor. It would certainly eliminate a lot of our waste problems today.

RADIOISOTOPE PRODUCTION AT FFTF

Anyway, one of the missions, as I recall, for FFTF would have been to produce radioisotopes. Now there is still a market in radioisotopes, I understand, in the medical field as well as for diagnostic work, scans, and so forth. Where are those radioisotopes being produced today?

Mr. YOUNG. They are being produced both by the private sector and reactors in other facilities. They are being produced at many Department of Energy facilities. Specifically, we looked at FFTF for that possible role. I think there have been some numbers bandied about that the market is going to grow from a few hundred million to $3 billion. I think it should be understood that only 1 to 10 percent of that $3 billion actually represents the cost of producing isotopes. The number is much smaller.

We have looked at FFTF. There are a few specific isotopes it can produce, but they also can be produced elsewhere. We do not see a revenue stream from those isotopes that would significantly change the conclusion that the $115 million a year in operating costs is too big a nut to crack.

NUCLEAR REACTOR STANDARDIZATION

Mr. MYERS. One last observation, not really a question. Eighteen years ago when the Chairman and I came to this subcommittee, we were told the Department was working on a standardized reactor that the utility could buy off the shelf. That was 18 years ago. And each year, yes, you are working on that. Now, today, you come in and tell us that it is going to be 1995 before you can develop one. Why in the world is it going to take till 1995 when I think the Department has been working on it for at least the 18 years the Chairman and I have been on the committee. What has the Department been doing on standardization? Does it take that much time? No wonder the utilities are in trouble.

Mr. YOUNG. I would say that there was some talk of standardization in the mid-1970s as a solution to nuclear power. At that time, all the orders in nuclear power died.

Mr. MYERS. Well, I say again, they didn't die, they were killed. But go ahead.

Mr. YOUNG. Yes, sir. I agree again; they were killed.

Mr. MYERS. They died, but with help.

Mr. YOUNG. Yes, sir. For that period from the mid-1970s on, I think both the industry and the Government really did nothing because of the lack of vision and lack of nuclear orders.

Mr. MYERS. That's a Catch-22 though.

Mr. YOUNG. In the mid-1980s, however, the Department of Energy began to support, as did the vendors, going to standardized designs. There are two standardized designs that are going to come on stream. One is an improved version of the present generation of reactors, and the present size of reactors. That standardization is due to be completed by 1991 for the boiling water reactor, which is in the fairly near term.

I think from the mid-1980s on, as the thoughts about nuclear power evolved, we saw a growing need for smaller reactors, potentially to be used by owners that didn't need these big plants. We

are supporting that concept at a pace we think can succeed to get the last half of that certification. There's three years worth of interaction with the NRC required to get there. So I am saying that we're supporting design efforts to have certified, 600 megawatt plants ready with licensing documentation by 1992, which is in the very near future.

Mr. MYERS. That'll be two to three years.

Mr. YOUNG. But, it takes several years to get through the review with NRC to certify it.

Mr. MYERS. I think it is your responsibility along with the NRC to come forth with the standardized design. You have got to develop some plans. I don't think they would ever develop anything. If you are waiting for NRC, it won't be this century even.

Mr. YOUNG. I have met with the Commissioners and laid out our——

Mr. MYERS. How did you do that?

Mr. YOUNG. In a public session.

Mr. MYERS. It would have to be, with all of them holding hands.

Mr. YOUNG. Yes, they were all there in a public session and we discussed the need to move forward promptly on their certification of these advanced reactor designs.

REACTOR DEPLOYMENT SCHEDULE

Mr. MYERS. I, for one, am not pleased with hearing that it is going to be 1992 to 1995 before we get it. I just don't see any excuse. Can you go back and sharpen your pencil and see if it can be done a little faster than that? I think that is entirely too long. We all know that if you wait until 1995 to come out with a standardized design, then industry is going to take—well, how long is it going to take NRC to approve it after you come up with the 1995 plan?

Mr. YOUNG. Well, that would be the completion of their approval in 1995.

Mr. MYERS. Is that 1995?

Mr. YOUNG. Yes, sir.

Mr. MYERS. You haven't been around the NRC as long as some of us have. We'll talk to them when they come in, too. But then it is going to take industry at that point 10 or 12 years, if they ever did build one. We are not going to have the electrical generation on line in time to help people. The young people who are in high school today are going to be old people by the time we get enough electricity for them. They will be sitting in the dark and will be buying everything from Japan because we won't have the power to produce it in this country. I think it is serious.

Mr. YOUNG. I take it seriously. You are absolutely right. It is deadly serious. Let me make this point. From the period when the large plant would be certified in the early 1990s, and from the period when the smaller plant would be certified by 1995, either of those plants could be completed and operating by the year 2000. That is our goal, to be able to have standardized nuclear plants operating by the year 2000.

Mr. MYERS. I apologize to my colleagues for belaboring this. We have already been warned in the Washington area of possible-

brown-outs this summer, rotating brown-outs. If any of you were in Florida over the Christmas holidays, we had rolling brown-outs. They call them rolling brown-outs, but what we were experiencing down there—I was down there visiting my sister and brother-in-law—was power on for 15 minutes and off for an hour and a half. And that's going to be the rule, not the exception, if we don't come on sooner than the year 2000 with additional power. They are already out of power in many areas of the country in extreme weather. The weather down there was below freezing for a couple of nights and that is what the problem was in central Florida. They have got a growing population there, and they admit they don't know what they are going to do. In five years from now they are going to have brown-outs year round, not just in extreme power situation, because with the growing population, they do not have the generation available to bring enough power. And we are not doing a whole lot to help them.

I have used my time. I may have a few other questions I will add to the record.

Mr. YOUNG. Our desire would be to do it earlier than that. I will look at what we can do.

Mr. MYERS. What it takes to get it a little quicker, I guess, is what we're wanting to know.

Thank you, Mr. Chairman.

Mr. BEVILL. The Chair recognizes Mrs. Boggs.

ADVANCED LIGHT WATER REACTOR CERTIFICATION

Mrs. BOGGS. Thank you, Mr. Chairman. Thank you, Mr. Young and Mr. Rousso.

Talking about the mid-sized Advanced Light Water Reactor, what is industry contributing to the effort to develop and certify it; what is the private sector's total contribution to this effort projected to be; and what is DOE's total cost?

Mr. YOUNG. The first plant being certified, which we call the Evolutionary Light Water Reactor, is 1200 megawatts. The private sector has put in about $200 million and we have put in $25 million. For the next generation of plants, the 600-megawatt plants, to provide more flexibility, there are two awards that the Department has made to proceed with that. The Department is putting $50 million into each one—one to Westinghouse and one to GE. The vendors and their partners are investing, in one case, on the order of $70 million, and the other on the order of $90 million, as I recall. So the Department is putting in less than half, but since these are new generation plants, the greater cost-share is considered appropriate.

Mrs. BOGGS. I understand that a key element to the basic production of the new reactors is first of a kind engineering. I also understand that until it is clear that the reactor is going to be certified and engineered, no buyers or investors are going to put private funds into the engineering phase. If we are going to assure a reactor is ready when the market is ready, should we be directing some funds into the engineering work as well?

Mr. YOUNG. I would say that's possible. That is one of the things we're looking at now. In the Fiscal Year 1991 budget, I think we

are supporting the kind of design work that would be needed to satisfy the NRC as to the safety of the plants. There also is a question of how much engineering needs to be done to assure that a vendor and a buyer could have nearly a fixed priced deal. One of the things that we will be looking at for 1992 and thereafter, is the effectiveness of our plan for supporting that.

Mrs. BOGGS. If this subcommittee were to direct some funds to the engineering work, what funding level do you think would be appropriate?

Mr. YOUNG. For Fiscal Year 1991?

Mrs. BOGGS. Yes.

Mr. YOUNG. I guess I would have to look at that and come back to you. We really haven't laid out extra money for that.

Mrs. BOGGS. Could you let me know for the record, please?

Mr. YOUNG. Yes, ma'am.

[The information follows:]

ADDITIONAL SUPPORT REQUIRED FOR ENGINEERING OF MID-SIZED LWR'S

Although all of the design and the associated documentation for the complete plant (including both the Nuclear Island and Balance of Plant) needed for certification will be completed under current DOE contracts, a substantial amount of additional work will be needed prior to construction of these plants. This work would include:

All first time engineering for the innovative manufacturing capability, tooling, techniques, and facilities to produce systems/structural modules and on-site prefabrication facilities.

All remaining/supplementary engineering to complete the final design, beyond that required for safety review and certification.

All construction-related design engineering, detailed drawings, and specifications.

WE believe that a 1992 start on this type of work would be consistent with the other activities (design certification, early site permit) leading to construction and operation of a nuclear plant at the turn of the century. Consequently, the Department will be evaluating the need for including first-of-a-kind engineering funding in its FY 1992 budget request.

HTGR INTERNATIONAL COST-SHARING

Mrs. BOGGS. Could you quantify for us the international cooperation in R&D on the HTGR?

Mr. YOUNG. In Fiscal Year 1991, we have $4 million of international cost-sharing. From Germany and Switzerland for fuels, graphite—which is a part of the design, metals and safety work, there is $900,000; from Japan for fuel testing and fuel design and technology, there is $1.1 million; from France for fission product testing, there is $1.5 million; and from the United Kingdom, again, for fuels work there is $500,000. So the $4 million is largely related to development of the fuel system.

Mrs. BOGGS. In addition to the funding requested by DOE for the HTGR, is there a separate funding request for defense work?

Mr. YOUNG. There is a separate request for the new production reactor, yes.

Mrs. BOGGS. How much?

Mr. YOUNG. I don't recall their total amount for the reactor. I can tell you that in their request is $29 million which is covering work that is common to the MHTGR commercial plant. We have worked out with them the R&D that needs to be done to support both plants commonly, and have agreed that they would spend $29

million to that end. We have a joint arrangement for managing that expenditure of money.

SPACE REACTOR RESEARCH

Mrs. BOGGS. Talking more about cooperation, do NASA and DOD contribute to the SP-100's Space Reactor research program? What is the level of this contribution, if they do?

Mr. YOUNG. Yes, they do. Let me just get a chart here. First of all, we have recently reaffirmed with both NASA and DOD that they will, in fact, fund and support this program. There has been some problem with that in the past. For fiscal year 1991, the DOE portion is $51 million; the NASA portion is $20 million; and the DOD, through the Strategic Defense Initiative Organization, is also $20 million. We have a Memorandum of Agreement that goes through fiscal year 1994 where that profile remains similar, and their funding gradually rises. The relative split is because we have to develop and test hardware early to go into their missions.

Mrs. BOGGS. The MMW special power system program, of course, does support the Defense space applications, as you have said. Why are these programs of importance to the Space Program?

Mr. YOUNG. Are you talking about the multi-megawatt reactor?

Mrs. BOGGS. Right.

Mr. YOUNG. That is a program that is funded solely by the Strategic Defense Initiative and it is so that they would have power to support active interception operations as part of their mission.

RADIOISOTOPE POWER SYSTEMS

Mrs. BOGGS. Could you describe the need for the radioisotope power sources in NASA's Ulysses, CRAF, and Cassini missions? Does NASA contribute to your activities in this area?

Mr. YOUNG. Yes, the arrangement in the past is that NASA pays for the radioisotope power generator that goes in the flight unit, and we would expect the same arrangement in the future. There would be one in each of these missions that you mentioned.

Mrs. BOGGS. The Ulysses mission scheduled for launch this October will carry a radioisotope, thermo electric and generator fuel capsule. What function does this RTG serve?

Mr. YOUNG. It serves the function of supporting on-board services, it serves the function of supporting telemetry for communicating back with the earth, and it supports the function of photography. The pictures we see of these planets are made possible because of these RTGs being on board.

Mrs. BOGGS. I understand the RTG will contain plutonium. What safety considerations are included in the design of these fuel capsules to protect Shuttle personnel or to protect the environment should an accident occur at launch?

Mr. YOUNG. The protection is in the design of the system. These RTGs consist of small capsules about three-eights of an inch or so, half of inch in diameter. They are of ceramic material design that is very hard and stays together. As I recall, they are triple encapsulated with materials so that in the event of even something like an explosion on the launch pad or an accident during re-entry, these capsules would stay intact and not release radioactivity. I am

sure sufficient shielding is there to protect any people on board these vehicles.

Mrs. BOGGS. Thank you. Do you have something further?

Mr. YOUNG. Yes, one thing I should point out, one of the things we spend our money on in this budget is a very comprehensive safety testing program where we put these capsules through extensive actual tests of crashing them and seeking to cause them to release radioactivity. These tests have proven that these devices do survive these very severe tests without releasing radioactivity.

LOUISIANA URANIUM ENRICHMENT FACILITY

Mrs. BOGGS. Thank you. And speaking of safety features in uranium enrichment—a commercial uranium enrichment facility has been proposed for construction in north Louisiana. What can you tell us about the nature of the technology proposed for this facility? Has there been much experience with the process? And what are the safety features associated with this type of enrichment process?

Mr. YOUNG. First, the technology of that plant is a version of what is called gas centrifuge enrichment that is being used for plants in Europe and the Soviet Union. It is a different design than the kind we use here, but it has a proven record.

From a safety and environmental standpoint, it is quite similar to the aspects that exist for our gaseous diffusion plants. The plant in Louisiana would be required to be licensed to NRC standards which are in the process of being determined; as well as environmental requirements, the Clean Air Act, the Clean Water Act; and so would be expected not to be a hazard to the environment. I would say for the DOE plants as well as this proposed plant in Louisiana that they contain very low amounts of radioactivity and that really the principle concern is not radiological, it is more toxicological as, for example, the releases from the plants of UF-6, which is an element that is used in both processes. For example, in the DOE plants, we have never had a member of the public exposed to that. The record is quite clean on that.

EDUCATION PROGRAMS

Mrs. BOGGS. Thank you.

Mr. Rousso, I was very pleased to see in your testimony that the Program Management and Technical Support Program will fund a fellowship in the historically black colleges and universities programs. Could you expand on that a little bit?

Mr. ROUSSO. We have historically had a program in that area. It is not a very large dollar value program, but we feel that it is quite important to sponsor such activities and we continue to do that as a means to foster science in those areas and to produce efforts that would support the program.

Mrs. BOGGS. I was also pleased to see that it would provide funds for your continued interaction with the National Congress of American Indians. Could you expand on that a little bit—what that interaction achieves and what it is intended to achieve?

Mr. ROUSSO. Actually, it is an extension from the dates prior to 1987, where we had three sites involved and we had several Indian Tribes that we were dealing with quite actively because their lands

were under consideration as possible repository sites for characterization. We continue to deal through the Congress as a unified body to represent the interests of many Tribes. Some Tribes are potentially involved with transportation effects once we do have an established site for both MRS and for a repository. If the Yucca Mountain site does prove out, there will be corridors of travel and transportation that may well cross Indian Reservations. So we keep an open communication with them through the Congress and through several national conferences that we hold on transportation; for example, where the participants can come and hear what our plans are, what our progress has been, and can voice their interests.

Mrs. BOGGS. The emphasis of the Secretary on the need for education and the need for the training so that we will have enough scientists and engineers and mathematicians to keep our country productive and competitive in the 21st century is very welcome by this Member and by this whole committee. I think that your activities are very much in line with his thinking, and I hope that you will continue to have the outreach particularly to the historically black colleges and universities because they are now forming sort of consortia, several of them in one group, to be able to deal more effectively with the Government programs. I think you would find that a very splendid development on the part of the historically black colleges and universities.

Mr. ROUSSO. I might also mention in that regard that we do have a fellowship program where we support approximately 50 graduate students in going on to obtain higher level degrees in the high level waste field. Hopefully, we can find places for those folks either in the Government service or in contractor forces in industry to further this important work and provide the technical talent we sorely need.

Mrs. BOGGS. Thank you very much. Thank you, Mr. Chairman.

Mr. BEVILL. All right. Are there any other questions? Mr. Myers, do you have anything further?

MONITORED RETRIEVABLE STORAGE

Mr. MYERS. Well, thank you, yes. Mr. Rousso, you briefly mentioned the MRS, the Monitored Retrievable Storage. At times the Department has, again, blown hot and cold. A few years ago there was a question about whether the Department really felt there was a need for the MRS. I think Congress has consistently felt that there was. As I read your remarks today, the Department is now looking for a site or at least is reviewing the site conditions or who might volunteer to accept a site. What is the status?

Mr. ROUSSO. If I could expand on that, sir. I don't know that—I have been with the program about four years now—we were never really hot and cold about an MRS. I think we felt that an MRS could be quite a useful adjunct to an integrated waste management system. Of course, it is written into the law, is part of the Act. What we were waiting for——

Mr. MYERS. That's right. Two, I think.

Mr. ROUSSO. Two MRS's?

Mr. MYERS. Doesn t it provide for two, the Act?

Mr. ROUSSO. No, two repositories.

Mr. MYERS. Oh, I guess that's right. Okay.

Mr. ROUSSO. However, there was in the 1987 Amendments, the creation of the MRS Review Commission which had as its sole function a review of the MRS and its rightful place in the program and how that can be utilized. The Commission reported out I believe in November of 1989. It came out with a variation where they supported two MRS' of some smaller capacity for different purposes. However, the concept of MRS, I think, was supported in that study. We now have determined, after going through our schedule review, which indicated that with all the work that had to be done and all the parties that had to be accommodated and satisfied to understand the significance and the scientific work, we would not have a repository until the year 2010. That meant that in order to try and get fuel from the utilities as early as possible, spent fuel that is building up in the pools all over the country, we would have to accelerate the MRS option. We looked at it technically and thought that with a volunteer site process, which we would hope the Negotiator would be able to bring to the table, or that we as a Department could pursue, because we are not precluded from doing that, with a volunteer process rather than should I say an adversarial process we could get an early site, and be able to build a basic facility—and I stress it would be a very simple storage only in the beginning—get through a licensing process, and be able to have something operating, at small capacity, but operating by early 1998. So we have laid out a program in our plan to do that and that requires some aggressive siting work now and laying out a strategy as to how to proceed. We will be doing that.

Mr. MYERS. With the lack of success and lack of cooperation you have had at Yucca Mountain, do you really think you are going to have a volunteer?

Mr. ROUSSO. Well, for an MRS facility, it is a surface facility of transient nature to move fuel in and out. I won't say it is a desirable facility from many points of view, but it is no worse than any nuclear plant or any other nuclear-type facility, which has had a history of difficulty but has nevertheless been achievable to a large measure. The repository is a 10,000 year activity and has a different set of parameters to work with and has met a much higher degree of reluctance, I would say. Although there is some interest at the entrepreneurial level, it has yet to surface with full support of any community or State, but I would think that is a possibility and we are pursuing those options.

REPOSITORY SCHEDULE

Mr. MYERS. Yucca Mountain is considerably behind schedule, at least the anticipated schedule. Has there been any injunction to stop work there or has it all been just built-in stoppages or delays?

Mr. ROUSSO. A combination of events. One is that obviously the work that goes on must meet full quality assurance standards and be able to pass the very strict licensing regime of the Nuclear Regulatory Commission, which is our regulator for this project. We have been spending a great deal of time in trying to develop and put in place and implement a fully qualified quality assurance pro-

gram. Now, I believe, eight out of nine of our major contractors at the site have passed their initial audits. We have yet to qualify the quality assurance program at Headquarters and at the project office at Yucca Mountain and, I believe, at one of the laboratories. Our program is to get that done by September and pass an audit with the NRC. Then we will have a completely integrated, approved, quality assurance program.

The State has field these law suits. They have delayed considerably our permit applications, which are required under their law. The State laws are a flow-down from Federal law, for air permits, and surface disturbing permits. These are normally granted within perhaps 75 days. They have been under constant review and inaction for a great period of time, sometimes turned back to us for comments, but clearly being held without response. We finally had to go to the courts to get a resolution and that's where we are today.

Mr. MYERS. A writ of mandamus, is that what you are attempting?

Mr. ROUSSO. I don't know the legal term, but we are asking for them to act on the permits.

Mr. MYERS. Have there been any court ordered injunctions prohibiting you from continuing to work?

Mr. ROUSSO. No.

Mr. MYERS. Okay. Just procedural more than anything else, then?

Mr. ROUSSO. Procedural, and we will be ready to get on the site and do some real work. Also, I would like to stress that although we must eventually get on the site and do surface disturbing work, deep borings and so forth, we have a body of data that——

Mr. MYERS. Have you stopped because of lack of permits to doing the borings?

Mr. ROUSSO. From doing new borings, yes. We are stopped from doing that.

Mr. MYERS. Were you stopped from doing that?

Mr. ROUSSO. From any new borings. But we have some 500 monitoring stations some 95 trenches, on-going studies, and have sampled some 37,000 feet of core from the Yucca Mountain area that we are continuing to analyze with our scientists. We continue to do design work because that is not precluded from being done by any permits. So there is a great body of activity that is on-going right now and will continue through 1990 and 1991 even without the permits. But that doesn't mean we can get along without the permits forever. We need to have that happen so we can get on site and do the shaft, for example.

Mr. MYERS. I have a number of other questions I will provide for the record.

Mr. MYERS. Mrs. Smith, Mr. Chairman, had to go on to another meeting. She has some questions also we would appreciate your answering.

Mr. ROUSSO. We would be glad to answer those.

Mr. MYERS. Get on with this standardization. Let's cut the time down.

Mr. YOUNG. Yes, sir. We will see what we can do.

Mr. BEVILL. Mr. Rousso, do you really think we will ever see the day we will have a central high level nuclear waste disposal area?

Mr. ROUSSO. Ever is a very long time, Mr. Chairman. I certainly think that we must have one. We must close the fuel cycle. We must show that we can, indeed, handle the waste problem in a permanent manner. The idea of leaving waste at the individual utilities, while safe because there is proven dry storage capability, swimming pool storage capability, eventually comes to a close. The NRC has said that there is no immediate problem until the year 2025. They do a review of confidence as to how the nuclear situation is progressing. They do not feel a compelling safety reason in the near time frame. But ultimately you cannot just leave fuel at 110 reactor installations around the country.

Mr. BEVILL. Is NRC moving on the Yucca Mountain program? Are they the authority to move on it?

Mr. ROUSSO. They are the authority to provide the licenses to go forward with the construction.

Mr. BEVILL. You are in for a long one then.

Mr. ROUSSO. They are the civilian arm.

Mr. BEVILL. They are going to spend the next two, three, or four years in the courts on it. The case you referred to, the State of Nevada versus NRC, we are talking about three or four years there, aren't we?

Mr. ROUSSO. It is the State of Nevada versus the DOE. Their position is that they have disqualified the site and, therefore, we should cease and desist. I believe in the interpretation that certainly our people have and I believe Members of the Congress have also that the law is written quite clearly: you can't disqualify the site until you have selected the site. You cannot veto a selection that hasn't been made. The point we are making is that we have only been asked to study this site first as a potential repository to find out if, indeed, is it suitable or is it not. That is a process of characterization that could take seven years or more. It is only at that point, when we have determined that the site is suitable, that we make that selection. The President would then recommend that to the Congress, and it is at that point that the State's rights come into play and they could veto. But they are vetoing now, which in our view has no legal standing.

Mr. BEVILL. Do you expect any State not to veto any area that you select? Let's say you spend seven years and billions of dollars getting it all set, then the State of Nevada can veto it, can't it?

Mr. ROUSSO. That is the State's right. And then I believe it passes back to the Congress for final resolution.

Mr. BEVILL. Then Congress would have to pass special legislation in order to get it underway?

Mr. ROUSSO. They would have to review the facts of the effort that we had undertaken up to that point and make a decision on the national behalf.

Mr. BEVILL. Yes. Well, I thank each of you for your fine testimony. Mr. Young, as we customarily do, your impressive biographical sketch will be placed in the record since this is your first appearance.

Mr. YOUNG. Thank you.

Mr. BEVILL. The subcommittee stands adjourned now until 1:00 p.m. on Monday.

[The questions and answers for the record and the statements of Mr. Young and Mr. Rousso follow:]

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Bevill. The Committee has a long-term interest in the AVLIS technology. The Committee is concerned that the deployment of this technology be made with the utmost care. A premature or ill-advised deployment decision could jeopardize the success of the program. Please describe the Department's deployment schedule.

Mr. Young. A deployment schedule is described in the Plan for the Demonstration, Transition and Deployment of U-AVLIS Technology, which was prepared by the Department in conjunction with the Lawrence Livermore National Laboratory staff. The program is structured around three major phases: plant scale technology demonstration, transition to deployment, and deployment. The technology demonstration phase will culminate in a plant-scale demonstration in September 1992. This demonstration will confirm through actual technical accomplishments, the enrichment performance and projected capital and operating costs.

During the transition to deployment phase, we will increase the level of industry involvement in all phases of the transition, and in addition, complete predeployment activities in order to be prepared for plant construction once a deployment decision is made. In increasing the level of industry involvement we will: initiate an industrial access program by August 1990 to broaden the base of industrial expertise; select a qualified industrial contractor by March 1991 as the Commercial Deployment Contractor to undertake production plant construction and/or operation; and use independent review groups including a Senior Industrial Review Group, SIRG,

and a Technology and Engineering Review Group, TERG, to review and assess program progress. Significant highlights of predeployment planning include selection of preferred alternative sites by January 1990, completion of a conceptual design report, and submission of a Nuclear Regulatory Commission licensing permit application by March 1991.

The deployment phase would begin following a decision to deploy a U-AVLIS production plant. This decision is scheduled for November 1992. In reaching a deployment decision we will prepare a series of data packages related to technology status, economic potential, the world enrichment market and other business considerations. Additionally, we will ask the independent review groups and industrial participants to provide their assessment of the value of the U-AVLIS technology to the U.S. enrichment enterprise.

If the decision is made to deploy U-AVLIS, the production plant must meet several requirements. First, its size and timing must meet the market needs and the financial objectives of the deploying organization. Second, sufficient confidence in the technical and economic performance of the technology must exist to provide an acceptable level of risk for commercial deployment. Third, its production costs must offer a competitive advantage. Further decisions on size, location, and timing of a production plant will be made at the time of the deployment decision in November 1992.

Both the Secretary and I believe that following this plan will lead to a sound, timely deployment decision.

LIQUID METAL FUEL CYCLE

Mr. Bevill. Your budget states that a goal of the program will emphasize the liquid metal fuel cycle. However, the budget for this activity decreases from $35 million in FY 1990 to $22 million in FY 1991. Please explain the shift in priority.

Mr. Young. The $35 million in FY 1990 and $22 million in FY 1991 to which you refer represents the funding for all Advanced Reactor Research and Development liquid metal reactor (LMR) activities, of which the metal fuel cycle is a portion. Within the LMR program, the emphasis remains on the metal fuel cycle.

The FY 1990 work was primarily for facility modifications now nearing completion. The FY 1991 efforts require less funding since they will be for the operation of the facilities with some funding to complete the Hot Fuel Examination-South modifications and initiation of the fuel recycle demonstrations. Near-term program priorities in nuclear energy are focused on activities to help remove institutional impediments to any new reactor and these efforts must take precedence versus long-term research such as IFR.

HIGH TEMPERATURE GAS-COOLED REACTOR

Mr. Bevill. The Department's budget for HTGR in FY 1990 was $15 million. The Department's budget in FY 1991 is $25 million. Please explain this shift in priority.

Mr. Young. There is no shift in priority. The FY 1990 and FY 1991 budgets are complemented by common technology development efforts in the New Production Reactor budgets and reflect the level of effort required to move forward with the standard plant design on a schedule that could produce a lead plant soon after the turn of the century.

PROGRAM OVERVIEW

Mr. Bevill. Your budget states that "Nuclear energy is a vital component of the national energy supply that contributes to national energy stability, security and strength." However, if you exclude the operation of facilities, waste cleanup, and the development of reactors for nonenergy use such as space and defense, the nuclear energy research and development budget is $78 million. Please explain how this supports your goals.

Mr. Young. The FY 1991 budget request includes $78.5 million for essential activities associated with our Light Water Reactor Program ($31.5 million), and our Advanced Reactor R&D Programs ($47.0 million).

By pursuing these activities, we believe that we can foster industry support to ensure the availability of these advanced reactors to meet electric power demands in the mid-to-late 1990's or early in the next century, thereby accomplishing our goals.

Mr. Bevill. When was the last commercial nuclear powerplant ordered and when do you think the next order will be placed?

Mr. Young. The last commercial nuclear powerplant was ordered in 1978, but was subsequently canceled. The last commercial nuclear powerplant order which was not subsequently canceled was in 1973. The next nuclear powerplant order is expected in the early to mid-1990s, assuming the following conditions:

The Advanced Light Water Reactor (ALWR) is expected to be the next nuclear plant ordered, based upon Nuclear Regulatory Commission (NRC) certification of the large (approximately 1300 MWe) evolutionary plant in 1991, and the mid-sized (600 MWe) simplified, passively safe plant in 1995. The specific type of ALWR ordered will depend upon individual utility needs and experiences.

Continued confidence by utilities that the Federal Government will honor its legal responsibility to take this waste on a timely basis.

Improvements in the NRC Standardization Rule of April 1989, will result in early resolution of emergency planning issues for new nuclear plant sites and reduction or elimination of the possibility of a post-construction licensing hearing.

Continued safe operation of current plants, more and better factual information available to the public on the benefits of nuclear power, and a

continued emerging recognition that nuclear power is one of the better "solutions" to environmental concerns over atmospheric pollution.

Utilities have to have confidence that their Public Utility Commissions will not disallow major portions of the plant cost from inclusion in the rate base as a result of "prudency" reviews performed after construction has been completed, and as a result of conditions over which they have little or no control such as electricity demand, inefficient safety licensing and regulation, etc.

New nuclear plants must have an expected busbar generation cost that is competitive with other base load alternatives.

Mr. Bevill. What is the Department of Energy doing to improve the possibility of a new commercial reactor being built?

Mr. Young. The Department is working closely with industry and the Nuclear Regulatory Commission (NRC) to improve the possibility that a new commercial reactor will be built. Three years ago the Department initiated the Advanced Light Water Reactor (ALWR) program to help revitalize the Light Water Reactor (LWR) option for meeting electrical needs in the 1990s and beyond. As part of this program, we are assisting reactor manufacturers in the submittal of two ALWR standard (approximately 1300 MWe) plant designs to the NRC. In addition, two mid-size plant design concepts, an Advanced Pressurized Water Reactor and an Advanced Boiling Water Reactor, utilizing predominantly passive safety features, are being developed and are to be certified by 1995. Technical support also is being provided to help resolve severe accident issues as applied to the ALWR designs. Finally, we are working to help eliminate the institutional, financial, and regulatory obstacles impeding the further growth of nuclear power in the country.

CIVILIAN NUCLEAR REACTORS

Mr. Bevill. Your budget assumes substantial contribution from the private sector in support of the High Temperature Gas Reactor and the Liquid Metal Reactor. What is the status of obtaining these outside funds and what is your realistic expectation of obtaining these funds?

Mr. Young. For the high temperature gas reactor, there are no contracts or agreements in effect for private sector contributions at this time. However, the Department is aware of a consortium considering a cost-sharing proposal. Further actions by the Department will depend on the specific requirements of this or any other proposals. It should be noted that the Gas-Cooled Reactor Associates (GCRA) and the Electric Power Research Institute (EPRI) have contributed to the programs through their support efforts. In FY 1990, this support amounted to approximately $2M for GCRA and $300K for EPRI.

The advanced liquid metal reactor is in the conceptual design phase. Optimizing the design to include the results of the actinide conversion capabilities is targeted for FY 1993. If the experimental work confirms our technical and economic expectations, we are optimistic that the private sector will be a cost-sharing participant.

REACTOR DESIGN

Mr. Bevill. Please explain your strategy to obtain an NRC certified standard reactor design for a large nuclear reactor.

Mr. Young. A major element of the Department's Advanced Light Water Reactor (ALWR) program, initiated in 1986, is a 50-50 cost-shared program with the nuclear industry to obtain Nuclear Regulatory Commission (NRC) Design Certification of two large (1250 to 1350 MWe) ALWR plants: the General Electric (GE) Advanced Boiling Water Reactor (ABWR), that is basically the same design as the two units ordered in Japan last year; and, the Combustion Engineering (CE) System 80+, that is a modified and improved version of the System 80 Palo Verde plant. These plant designs have been submitted for certification as standard plants under the NRC 10 CFR 52 regulations issued last year. All of the GE ABWR safety analysis report has been submitted to NRC for review, and their Final Design Approval is expected by the end of this year; barring unforeseen delays, our objective is to acquire certification by the end of 1991. The CE System 80+ design submittals have encountered delays arising from the need to expand the scope of the design submitted for certification to comply with 10 CFR 52 requirements; assuming the availability of resources to complete this work, the System 80+ certification would be expected about 1 year later (end of 1992).

Mr. Bevill. How will your program to develop a standardized design allow for competition in the manufacture of reactors?

Mr. Young. The Department has been helping to support the certification of two large plants designed by General Electric and Combustion Engineering. At the time the Department's program was initiated, Westinghouse already had submitted their large Advanced Pressurized Water Reactor design for Nuclear Regulatory Commission Preliminary Design Approval (before the advent of 10 CFR 52). Assuming Westinghouse will complete the certification process under the new regulations, there will be three competitive domestic large plant designs on the market in the 1990s. The new Departmental program for detailed design and certification of Simplified Passive Advanced Light Water Reactor plants of smaller size (600 MWe), will include the competitive designs of Westinghouse (AP600) and General Electric (SBWR).

Mr. Bevill. Please explain your program to develop an NRC certified standard reactor design for an improved medium sized reactor.

Mr. Young. Based upon the evaluation of competitive proposals responding to our request for proposals, the Westinghouse AP600 design and General Electric Simplified Boiling Water Reactor designs were selected, in September 1989, for the Department's Simplified Passive Plant Program. This program calls for the detailed design and submittal for NRC certification of these two simplified, mid-size (600 MWe) standard plants by mid-1995. Both designs are characterized by the use of predominantly passive safety systems. The contract calls for the Department to fund the lesser of $50 million or 50 percent of the total cost of the work for each plant, with the remainder paid by the contractors. In both cases, the total cost will greatly exceed $100 million. The Westinghouse contract was signed on February 27, 1990, and the General Electric contract is expected to be signed by the end of March.

ACTINIDE BURNING

Mr. Bevill. Please describe further the application of the Advanced Liquid Metal Reactor to provide improved waste management options through the recycling and burning of long-lived radioactive actinide elements.

Mr. Young. The Advanced Liquid Metal Reactor (ALMR) has a very fast neutron spectrum, which is very efficient in fissioning actinides. The design will be optimized to capitalize on this unique feature of the ALMR. The actinide recycle program, a new initiative to be implemented in FY 1991, will focus on studies to determine how long-lived actinide elements might be removed from spent Light Water Reactor fuel and converted into fuel for an ALMR.

With removal of nearly all of the actinides from the waste streams, the radioactive toxicity of the waste sent to a geologic repository is due to the fission products therein. After about 300 years, the waste toxicity level decays to a level no greater than that of the source uranium ore from which all of the actinides and fission products were derived. Without removal, the actinides dominate the toxicity of the material in the repository for thousands of years at a level orders of magnitude higher than that of the source uranium ore. An option to reduce the amount of radioactive toxic material sent to a repository could, if exercised, enhance public acceptance of nuclear power.

PLANT LIFE EXTENSION

Mr. Bevill. Both the DOE and NRC budget includes funds to support the extension of nuclear powerplant life. Explain how these efforts are coordinated to ensure that there is not unintentional redundancy.

Mr. Young. The main reason redundancy between programs does not exist is that resources of the Department deal more with preparation of material to be submitted to NRC, whereas NRC resources deal with review of submitted information.

However, coordination interfaces have also been put in place to ensure that there is no unintentional redundancy. These interfaces include exchange of program plans, schedules, budgets, and project descriptions. Also, periodic meetings on interim results from respective activities are held to ensure each organization is aware of the status of program activities. This coordination among the NRC, DOE, and the Nuclear Management and Resources Council has been formalized through letter agreements.

Mr. Bevill. Describe the coordination process to complement the Electric Power Research Institute (EPRI)/industry work on advanced LWRs.

Mr. Young. The Department has been working very closely with the industry, particularly through EPRI, to develop improved light water reactors.

One major activity where EPRI has had the lead has been in the preparation of the Advanced Light Water Reactor (ALWR) Utility Requirements Document. This document is a set of detailed management, design, and operating requirements as specified by the utilities for the next set of light water nuclear powerplants and has been developed from the large experience base of the more than 100 operating U.S. nuclear plants. The Requirements Document for the "evolutionary plant" (the large plants) is essentially complete and undergoing Nuclear Regulatory Commission (NRC) review. The reactor manufacturers engaged in the Department's large plant certification program--General Electric and Combustion Engineering--helped to prepare this document and evaluated their designs being submitted for NRC certification for conformance with this document. In the large majority of cases, the designs comply with or were modified to comply with the Requirements Document.

EPRI currently is preparing the separate Utility Requirements Document which will apply to the simplified passive ALWR plants. Our new contracts with Westinghouse and General Electric call for evaluating the AP600 and

Simplified Boiling Water Reactor designs for conformance with this document.

The Department also participates directly with EPRI in the development of advanced reactor requirements in the area of severe accident prevention and mitigation. The Department's Severe Accident program assists EPRI in identifying and assessing design features to improve severe accident response.

The Department and EPRI maintain a close coordination of program and technical management or our respective programs to insure that these programs are in close harmony in achieving our mutual objectives.

MODULAR HIGH TEMPERATURE GAS-COOLED REACTOR

Mr. Bevill. Please describe your strategy for the development of a High Temperature Gas Reactor. How has this strategy changed since last year?

Mr. Young. A standard modular high temperature gas-cooled reactor plant design is being developed for NRC review and approval. Technology development is also underway to support the design work. It is our expectation that through a cooperative effort with the private sector, an arrangement can be established to erect a lead plant based on the standard design. The Department has been contacted by a private consortium which expressed their interest in developing a funding initiative. We will consider this and any other initiatives that may be received. This strategy is consistent with last year's approach.

STRATEGY FOR DEVELOPMENT OF LIQUID METAL REACTOR

Mr. Bevill. Please describe your strategy for the development of a Liquid Metal Reactor. How has this strategy changed since last year?

Mr. Young. The advanced liquid metal reactor design program will continue with increased emphasis on actinide conversion. The nuclear island conceptual design is scheduled to be completed by January 1992. Features testing of components is scheduled to be completed by September 1992. The Department of Energy is considering issuing a Request for Proposal (RFP) on design optimization for actinide conversion in June 1993. Resolution of all key safety and licensing basis issues is targeted for January 1994. The next phase in the design program, namely the preliminary design, will depend upon the results of the overall IFR program.

DEMONSTRATION PROTOTYPE OF AN ADVANCED REACTOR

Mr. Bevill. Do you think it would be necessary to satisfy NRC and public safety concerns by building a demonstration prototype of an advanced reactor prior to commercialization?

Mr. Young. The NRC has stated that the successful operation of a demonstration prototype reactor module is a prerequisite for issuing a commercial license for the Advanced Liquid Metal Reactor and for the Modular High Temperature Gas-Cooled Reactor. No demonstration is required for the Advanced Light Water Reactor.

PUBLIC PERCEPTION

Mr. Bevill. What is the Department doing to improve the public perception of nuclear energy?

Mr. Young. The Office of Nuclear Energy is undertaking a number of activities to improve public understanding and perceptions about nuclear energy. First, we are providing printed materials on nuclear energy to the public, schools, utilities and other organizations and responding to public and press inquiries on nuclear topics. Second, we are supporting museum exhibits at the Chicago Museum of Science and Technology and the Oak Ridge Energy Museum which inform and educate the public about nuclear power. Third, we are working with various educational institutions to improve the understanding of nuclear power and encourage students to pursue careers in nuclear energy. We have developed and are providing curricular materials (e.g. the "Harnessed Atom"), slide presentations and "National Science Week" materials for use in schools and other forums. In addition, we are providing scholarships, fellowships and support to faculty and students at Historically Black Colleges and Universities for work and studies in nuclear science, engineering, and associated disciplines. We are also supporting graduate study and research through fellowships at academic institutions and appropriate DOE facilities in areas supportive of the Nuclear Energy program.

COMMERCIAL NUCLEAR REACTORS

Mr. Bevill. Describe the DOE role in the research effort leading to an advanced or improved commercial nuclear reactors.

Mr. Young. The Department's Advanced Light Water Reactor (ALWR) program includes the submittal for Nuclear Regulatory Commission (NRC) Design Certification of two large ALWR standard plants: the General Electric (GE) Advanced Boiling Water Reactor (ABWR) and the Combustion Engineering (CE) System 80+. For the GE ABWR, we anticipate NRC Final Design Approval by the end of this year, and Certification by the end of 1991. The CE System 80+ design is about 1 year behind this schedule, based on the availability of resources.

The Department's Simplified Passive Plant program will support the detailed design and submittal for NRC Design Certification of the Westinghouse AP600 and GE Simplified Boiling Water Reactor plant designs by mid-1995. Our preceding program for these designs, to be concluded this year, included conceptual design development and key features development testing.

The Department is also supporting two other advanced reactor designs that could be certified by early in the next century. Conceptual design has been completed on a standard modular high temperature gas-cooled reactor plant design. A private sector consortium has expressed an interest in developing a funding initiative to build a lead plant in a cooperative effort with the Government.

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Conceptual design on the advanced liquid metal reactor is continuing with increased emphasis on actinide conversion. The Department of Energy is considering issuing a Request for Proposal in FY 1993 for a design optimized for actinide conversion. Further design efforts will depend upon the progress made in the metal fuel cycle program and the actinide recycle work to be initiated in FY 1991.

Mr. Bevill. Within the Light Water Reactor program, please describe and indicate the funding for the large Advanced Light Water Reactor, Advanced mid-size reactors and License Extension.

Mr. Young. I would like to insert in the record the funding for these activities (the information follows).

Large Advanced Light Water Reactors: cost-shared 50-50 with the contractors.

- o General Electric (GE) Advanced Boiling Water Reactor Certification - total cost to the DOE will amount to approximately $11.3 million. Through FY 89, $8.3 million has been spent; remaining $3.0 million to be spent in FY 90 and FY 91 to successfully complete the program. The FY 91 request is $0.5 million.
- o Combustion Engineering (CE) System 80+ Certification - total cost to the Department of Energy (DOE) through the end of FY 90 will amount to $12 million; $10.3 million has been spent through FY 89. DOE currently does not have FY 91 funds to continue this program. Because of plant scope change needed to meet Nuclear Regulatory Commission certification requirements, CE estimates additional funding of $10 to $12 million would be needed to complete the full plant certification program.

Advanced Mid-Size (Simplified Passive) Reactors:

- For our current program, which will be concluded the end of FY 90, under 50-50 cost-shared contracts with Westinghouse (AP600 design) and GE (Simplified Boiling Water Reactor design), the total cost to DOE will amount to $27.3 million; $24.5 million has been spent through FY 89. No FY 91 funds are being requested.
- In the new contracts for the design and certification of Westinghouse AP600 and GE SBWR simplified passive plants, the terms call for DOE expenditures of the lesser of $50 million or 50 percent of the total cost for each plant. Since design and certification for each plant will greatly exceed $100 million total cost, the DOE funding is a total of $100 million over the period from FY 90 to FY 95. The funding in FY 90 will amount to $12.3 million of this total. The FY 91 request is $20 million.

Plant Life Extension Program:

- The DOE funding for this program through the end of FY 90 amounts to $11.3 million. Anticipated funding for the period from FY 91 to FY 95 is expected to be about $7 million. The FY 91 request is $4 million. The cooperative program includes substantial cost-sharing by the nuclear industry.

Mr. Bevill. Describe each of the Advanced Light Water Reactor efforts and include an assessment of the appropriate Federal role.

Mr. Young. The Department's Advanced Light Water Reactor (ALWR) program includes the following elements: the Design Certification of two large standard plant designs: the General Electric Advanced Boiling Water Reactor and the Combustion Engineering System 80+; design, development and Design Certification of two simplified passive plants: the General Electric Small Boiling Water Reactor and the Westinghouse AP600; the Plant Lifetime Improvement Program; Early Site Permit Demonstration; and the Advanced Reactor Severe Accident Program.

The overall objectives of the program are: to make ALWR plant designs available for ordering in the 1990s to help satisfy the Nation's energy needs; to demonstrate the efficacy of the new NRC regulations (10 CFR 52) for standard plant design certification, early site permits, and a more efficient licensing process; and to extend the lifetime of currently operating reactors to avoid a shortfall of energy supply over the next three decades should these plants be retired. The corollary objectives that are satisfied include revitalization of the nuclear industry to competitively sell and build these new plants, and the reduction in utility financial risks that will motivate the sale of these plants.

The common thread of all of these complementary program elements is that they are all cooperative, cost-shared programs with the nuclear industry, in which the Government's cost share is by far the smallest. A

second commonality is that the technical results are based on the cooperative efforts of the suppliers, the utility customers, and the Government. The Department believes that work to accomplish these objectives is consistent with the objectives of the Department and, therefore, is an appropriate Federal role.

Mr. Bevill. Describe the DOE work that is performed in conjunction with EPRI to obtain a licensability certificate from NRC.

Mr. Young. The Department is helping to support, on a 50-50 cost-shared basis with the reactor suppliers, the NRC Design Certification of two large Advanced Light Water Reactor (ALWR) plant designs: General Electric (GE) Advanced Boiling Water Reactor, and Combustion Engineering (CE) System 80+. We are also supporting, on a cost-shared basis, the detailed design and NRC Certification of two simplified passive plant designs of 600 MWe rating: Westinghouse AP600, and GE Simplified Boiling Water Reactor (SBWR). We anticipate NRC Certification of the GE Advanced Boiling Water Reactor by the end of 1991, and, subject to the availability of resources, the CE System 80+ about 1 year later. The AP600 and SBWR simplified passive plants are expected to be certified by mid-1995.

EPRI has and is preparing the ALWR Utility Requirements Document for both the evolutionary (large plant) and passive plant designs. In the DOE program, the large plant designs have been evaluated for conformance with these utility requirements, and the great majority of these requirements have been incorporated. Similarly, the passive plant designs will be evaluated for conformance with the utility requirements. DOE and EPRI maintain close technical and programmatic coordination and communication.

CIVILIAN NUCLEAR REACTORS

Mr. Bevill. Please provide a breakdown of the complete funding for MHTGR, Advanced Light Water and ALMR in FY 1989, FY 1990 and FY 1991.

Mr. Young. The breakdown of the complete funding for the High Temperature Gas-Cooled Reactor, Advanced Light Water and Liquid Metal Reactor in FY 1989, FY 1990 and FY 1991 is shown in a table which I would like to insert in the record.

(The information follows:)

($'s in Millions)

	FY 1989	FY 1990	FY 1991	Total
High Temperature Gas Reactor (HTGR).....	$ 19.8	$ 22.5	$ 25.0	$ 67.3
Advanced Light Water Reactor (ALWR).....	26.5	24.4	31.5	82.4
*Liquid Metal Reactor (LMR).....	54.2	36.2	22.0	112.4
Subtotal....	$100.5	$ 83.1	$ 78.5	$262.1
*Facilities.....	144.81/	169.72/	140.5	455.0
Total.....	$245.3	$252.8	$219.0	$717.1

*The most significant activity at Nuclear Energy Facilities (ANL, ETEC, WHC) is in support of the LMR research and development programs.

1/ Includes corrective actions, waste management, and prior year portion of reprogramming.

2/ Nuclear Energy budget shown only; $5.0M expected from Defense Atomic Energy Appropriations consistent with Conference Report associated with P.L. 101-101.

ADVANCED LIQUID METAL REACTOR

Mr. Bevill. Is DOE currently considering financing a demonstration-scale advanced reactor?

Mr. Young. At this time, DOE has no plans to finance a demonstration-scale advanced liquid metal reactor or modular high temperature gas-cooled reactor.

Mr. Bevill. Describe the DOE role and success in developing a standard reactor design.

Mr. Young. In the Advanced Light Water Reactor program, the Department is supporting the NRC Design Certification of two large standard plant designs: General Electric (GE) Advanced Boiling Water Reactor (ABWR), and Combustion Engineering (CE) System 80+. The GE ABWR is expected to be certified by the end of 1991. The CE System 80+ design has encountered some delays due to the need to expand the plant scope being submitted for certification; subject to the availability of resources, this design may be certified about 1 year later.

In the new DOE Simplified Passive Plant program, the detailed design and submittal for NRC certification of the Westinghouse AP600 and GE Simplified Boiling Water Reactor standard plants will be accomplished, with the objective of acquiring certification by mid-1995.

FAST FLUX TEST FACILITY

Mr. Bevill. Your budget submission assumed the shutdown of the FFTF starting in FY 1990. Since this proposal was not accepted by the Congress, what additional funds are required in FY 1991 and what is your proposed source of these funds?

Mr. Young. The fiscal year 1991 Budget Request for the FFTF at Hanford is $46.6 million, which is the amount required to conduct shutdown activities in that year. Should the FFTF continue the current level of activities in fiscal year 1991, additional funds in the amount of approximately $55 million would be required. We have not identified the source of funding to continue operations.

NRC LICENSING REFORM RULE

Mr. Bevill. Please provide the committee your views of the recent NRC one-step licensing rule. What are the advantages and shortcomings of the rule?

Mr. Young. Reform of the system by which nuclear powerplants are licensed is critical if the nuclear power option is to be part of our Nation's energy future. Notwithstanding the technical soundness and extraordinary safe operating record of nuclear powerplants, the utility industry and the financial community are reluctant to risk investment in nuclear power unless they can have reasonable assurance that a plant can be operated without undue delay after it is completed. The NRC recent standardization and licensing reform rule (10 CFR 52) is a major step toward the needed reform, but it retains a few aspects that will discourage the rule's use.

Advantages of the rule include the following. It permits early site approvals and banking of future reactor sites, establishes standard plant design certifications that are approved by rulemaking, and establishes a combined construction and operating license that resolves all safety issues prior to start of construction in one combined process with a consolidated adjudicatory hearing. The combined license process provides for inspections, tests, and analyses that confirm that all conditions of the license have been met and requires that at appropriate intervals during construction, the Commission staff publish notices of successful completion of inspections, tests, and analyses.

The major shortcoming of the rule is that it does not eliminate the possibility of lengthy procedural delays when a plant is ready for operation. It retains the possibility of a formal adjudicatory hearing on whether one or more acceptance criteria in the combined license have been met or on a petition to modify the terms and the conditions of the combined license.

In addition, emergency planning issues are not fully addressed, particularly those involving tests and exercises. Their resolution is subject to a formal adjudicatory hearing when the plant is ready for operation. The rule also requires an opportunity for a formal adjudicatory hearing for any requested amendment of the terms of a combined license and requires that any hearing held be completed before operation. The rule should be revised to require Commission consideration of amendments to combined licenses to be the same as for amendments to operating licenses, which allow approval of amendments without a hearing if no "significant hazard considerations" are involved.

The Department believes that resolution of these problems is necessary to allow nuclear power once again to be seen as a viable option and to play a significant role in our future national energy supply. Legislation may be required to allow resolution of these shortcomings of the rule.

ACTINIDE RECYCLE PROGRAM

Mr. Bevill. Please describe the research program initiated in FY 1991 to develop an Actinide recycle program. What is the FY 1990 and FY 1991 funding for this program?

Mr. Young. The $2 million in FY 1991 is the initial funding requested for this program. Exploratory process studies will be initiated on how long-lived transuranic elements might be removed from spent Light Water Reactor (LWR) fuel and converted into fissile feed material for liquid metal reactors. Conversion processes, in which the very radioactive rare earth elements cannot be separated from the transuranic actinides, will be studied analytically and experimentally through pyrochemical processes. Burning the long-lived actinides from spent LWR fuel in ALMRs could be carried out to reduce the amount of hazardous, long-lived radioactive material in a geological repository.

COMMERCIAL NUCLEAR REACTORS

Mr. Bevill. Describe the relative safety of the Advanced Large Light Water Reactor, the passively safe advanced modular light water reactor, the Advanced Liquid Metal Reactor and the Modular High Temperature Gas Reactor.

Mr. Young. All of these advanced designs must meet all of the appropriate safety requirements and criteria necessary for NRC to judge the safety of these designs, including consideration of the latest severe accident policy. They all incorporate improvements, updatings, and simplification compared to the currently operating light water reactor (LWR) plants. These changes would be expected to enhance safety and reliability, but, this does not mean that the currently operating reactors are in any way unsafe.

There are certainly some major differences among the three concepts. An example of a design difference is the degree of required action by plant operators in an accident situation. The current generation LWRs need operator action as do the evolutionary LWRs; the mid-sized LWRs allow delayed operator action due to their passive safety features. On the other hand, the Modular High Temperature Gas Reactor and Liquid Metal Reactor presumably may require even less or no operator action due to their even greater use of passive safety features.

Regardless of these design differences, each of these reactors can be safely operated and they will be licensed if, and only if, they are judged to meet the rules and regulations Nuclear Regulatory Commission's safety requirements.

MODULAR HIGH TEMPERATURE GAS-COOLED REACTOR

Mr. Bevill. Describe the coordination of the MHTGR and New Defense Production reactor. What effort is being made to maximize the research and development to ensure civilian as well as defense applications wherever possible?

Mr. Young. A group representing both programs identifies areas of commonality and coordinates research and development to the maximum extent practicable. The technology development and design activities for each program have been reviewed and common activities identified and coordinated. Examples of common areas include: fission product behavior, materials development, reactor shielding, vessel and cross ducts, and large component development. In addition, there are a number of other areas where portions of the work are common. As the design progresses, the list of common elements will be continually reassessed to assure the most effective utilization of Department funding. NE's program planning is based on utilizing common efforts funded by NPR. These resources will enable the commercial program to meet program planning level goals.

ENERGY TECHNOLOGY ENGINEERING CENTER

Mr. Bevill. Describe the program utilization of the ETEC in California. Describe how the utilization of ETEC differs in FY 1991 from the planned FY 1990 utilization.

Mr. Young. The Energy Technology Engineering Center is utilized to conduct system and component development test programs for fission energy, solar, conservation, geothermal, fossil, fusion, and other programs.

Although consideration was given in the FY 1990 program to placing LMR-related test facilities in layup status, Congress provided for sufficient funding to continue key activities in FY 1990. These activities include completion of performance testing on the helical coil steam generator and removal of this test article in preparation for installation of the double wall tube steam generator. In FY 1991, this installation will be completed, along with the installation of a few tube test model steam generator arriving this month from Japan. Testing of both of these steam generators is scheduled to begin in mid FY 1991. This effort is part of a cooperative program under a contract between DOE and the Japan Atomic Power Company.

Also in FY 1990 and FY 1991, testing and developmental activities will continue in support of other DOE programs, other agencies, the private sector, and international programs.

We are currently preparing a report on the long term utilization of ETEC as requested in House Report 101-96, which accompanied the Energy and Water Development Act, 1990 (P.L. 101-101). This report will be provided to the appropriate Committees later this month.

Mr. Bevill. At what time would you anticipate that one of the advanced reactor technologies would be available for NRC certification and actual commercial sale?

Mr. Young. With regard to the Advanced Light Water Reactor, the large General Electric (GE) Advanced Boiling Water Reactor (BWR) plant should be certified by NRC by the end of 1991. The Japanese have already purchased two units. We would expect GE to offer this unit for commercial sale in the United States as soon as it is certified.

The Combustion Engineering System 80+ large plant design should be certified by about the end of 1992, subject to the availability of resources. We assume it also would be offered for domestic sale at that time.

The simplified passive plants being designed by Westinghouse (AP600) and GE (Simplified BWR) should be certified by mid-1995. These vendors will undoubtedly develop a means that would facilitate some form of turn-key offer of these plants in the mid-1990s.

ADVANCED LIQUID METAL REACTOR

Mr. Bevill. What vendors are involved in the ALMR program and what activities will each be engaged in FY 1990 and FY 1991?

Mr. Young. General Electric has the lead design and overall coordination responsibility. Westinghouse is involved in the heat transport and reactor control system. Bechtel has the architect-engineering responsibility for the nuclear island; Burns and Roe has parallel responsibility for the balance of plant facilities. Babcock and Wilcox is developing the helical coil steam generator. Foster Wheeler is involved in the intermediate heat exchanger design. Stearns-Roger/United Engineers and Constructors are concentrating on the engineering aspect of modularization.

MODULAR HIGH TEMPERATURE GAS-COOLED REACTOR

Mr. Bevill. Who are the industry participants in the MHTGR program?

Mr. Young. The industry participants in the modular high temperature gas-cooled reactor program include Combustion Engineering, General Atomics, and Bechtel National who comprise the team responsible for the nuclear island portion of the plant; Stone and Webster is responsible for the balance of plant.

Oak Ridge National Laboratory is responsible for technology development tasks needed to support design and licensing activities. The Idaho National Engineering Laboratory provides additional technical support.

The final participants are the Gas-Cooled Reactor Associates and the Electric Power Research Institute. They provide the necessary interface between the Department and the user utilities.

Mr. Bevill. Please describe the extent of the international participation in the HTGR?

Mr. Young. International participation in the MHTGR program presently includes information and technology exchanges with West Germany, Switzerland, France, Japan and the United Kingdom. The multilateral agreement with West Germany, Switzerland and France has been underway for 13 years and has included several technical personnel exchanges. The agreement with Japan is in its fifth year and it includes a joint fuels performance test for which the Japanese are contributing $2.05 million over a six-year period. In addition to these international cooperatives, the U.S. is a major participant in the activities of the International Atomic Energy Agency's Working Group on Gas-Cooled Reactors.

ADVANCED LIQUID METAL REACTOR

Mr. Bevill. Describe the extent of the international and domestic industrial participation in the ALMR program?

Mr. Young. Our current agreements with Japan are expected to contribute approximately $15 million in FY 1991 to the ALMR program. Italy has been providing the equivalent of $1.5 million in direct support of the General Electric design effort for the Power Reactor Inherently Safe Module. The design contract signed with General Electric in 1989 was negotiated on a "no fee" basis.

NUCLEAR ENERGY FACILITIES

Mr. Bevill. Please provide a list of all facilities funded in the nuclear budget and include the funding for FY 1989, FY 1990 and FY 1991.

Mr. Young. Funding by Fiscal Year for facilities (expressed in millions of dollars) is contained in this table which I will place in the record.

	FY 1989	FY 1990	FY 1991
Hanford Site			
FFTF	63.7	85.1	40.6
FMEF	2.0	1.0	1.0
308 Building/FAA	7.4	8.2	5.0
	73.1	94.3	46.6
Argonne National Laboratory-West			
EBR-II	32.2	37.9	47.7
HFEF-N	12.0	13.0	13.5
HFEF-S	7.8	8.4	8.9
TREAT/ZPPR	5.3	6.6	6.8
	57.3 1/	65.9	76.9
Energy Technology and Engineering Center			
SCTI	8.4	4.7	11.3
Other	3.0	2.2	3.2
	11.4	6.9 2/	14.5
Other	3.0	2.6	2.5
TOTAL	144.8	169.7	140.5

1/ Includes corrective actions, waste management, and prior year portion of the reprogramming.

2/ Nuclear Energy budget shown only; $5.0M expected from Defense Atomic Energy Appropriations consistent with Conference Report associated with P.L. 101-101.

SPACE/DEFENSE POWER AND ADVANCED RADIOISOTOPE POWER SYSTEMS

Mr. Bevill. Please describe each of the systems included in Space/Defense Power Systems.

Mr. Young. The program includes three primary efforts - the SP-100 space reactor, the multimegawatt space reactor and thermionic fuel element verification.

The SP-100 space reactor program's principal focus is to develop power systems technology capable of generating from 10's to 100's of kilowatts electric. The SP-100 utilizes a liquid metal cooled reactor and thermoelectric power conversion. SP-100 is being developed jointly by the Department of Energy, the Department of Defense, and the National Aeronautics and Space Administration. The National Aeronautics and Space Administration's primary interest is in advanced space missions such as the Human Exploration Initiative, and the Department of Defense usage would be for housekeeping power for various space assets, such as Strategic Defense Initiative space system devices.

The Multimegawatt Space Reactor Program has been a jointly sponsored activity of the Department of Defense and the Department of Energy to establish the technical feasibility of at least one multimegawatt space reactor concept which can meet SDI's short-duration, high-power burst, space power needs in the range of a few megawatts to hundreds of megawatts. Additionally, with nuclear propulsion being identified as a critical technology need for the President's Human Exploration Initiative, NASA has

also recently expressed interest in multimegawatt space reactor systems for nuclear propulsion applications and has been exploring the possibilities of NASA and DOE working together on a joint nuclear propulsion effort. At this time, three possible multimegawatt systems are currently being considered, from which one or more concepts may be selected for further development.

The Thermionic Fuel Element program is a component hardware testing effort to resolve the key technical issues that led to the nonselection of thermionics for the SP-100 program. Thermionic Fuel Element assemblies are being developed and life-tested. Thermionics is an alternative electrical conversion system with applications in the power range of SP-100, and has growth potential beyond the current SP-100 power range. Development of a total thermionic system is not currently being pursued.

ADVANCED RADIOISOTOPE POWER SYSTEMS

Mr. Bevill. Please describe each of the systems included in Advanced Radioisotope Power Systems.

Mr. Young. The scope of the Advanced Radioisotope Power Systems Program is to develop isotope-based power systems capable of providing from several watts of electricity up to 10 kilowatts. The specific power systems we currently produce or have under development include the General Purpose Heat Source (GPHS) Radioisotope Thermoelectric Generator (RTG), the Modular Radioisotope Thermoelectric Generator, the High Performance 150 watt Radioisotope Thermoelectric Generator, the Two Watt Radioisotope Thermoelectric Generator, and Radioisotope Heater Units.

The first two systems are for National Aeronautics and Space Administration space exploration missions. The GPHS system was used on the Galileo and Ulysses spacecraft and will also be used for the upcoming Comet Rendezvous Asteroid Flyby and Cassini launches in 1995 and 1996. The modular RTG will be used in future space science and applications missions and the Human Exploration Initiative. These generators meet mission power needs in the 250 to 600 watt range. Several of these missions also use radioisotope heater units.

The high performance and two watt generators are for classified terrestrial missions requiring power sources in the two to 150 watt range. These generators are designed to be used in remote environments without periodic maintenance.

SPACE/DEFENSE AND ADVANCED RADIOISOTOPE POWER SYSTEMS

Mr. Bevill. Describe the shift in categories from the FY 1990 to FY 1991 budgets.

Mr. Young. There are no subactivity adjustments from the FY 1990 budget for either the Space Reactor or Advanced Radioisotope budget activities. However, titles for these two activities were revised to better describe the ongoing and proposed work. Space and Defense Power Systems is now titled "Space Reactor Power Systems", and Advanced Nuclear Systems is now titled "Advanced Radioisotope Power Systems".

Mr. Bevill. Describe which of the systems under development have an application to SDI.

Mr. Young. Two reactor systems are under development which have application to the Strategic Defense Initiative (SDI). These are the SP-100 Space Reactor and the Multimegawatt Space Power Systems. There are no radioisotope power systems under development that have an application to SDI.

In addition to SP-100's primary thrust in support of NASA civilian missions, SP-100 Strategic Defense Initiative missions include space surveillance spacecraft and space-based defensive weapons systems, as well as the potential for higher-powered orbital transfer vehicles that could be used by the Department of Defense and the National Aeronautics and Space Administration. The multimegawatt space reactor system was being pursued primarily in support of SDI space-based defense weapons system. However, the technologies being developed are basically the same as those needed for civilian nuclear propulsion activities.

ADVANCED RADIOISOTOPE POWER SYSTEMS

Mr. Bevill. Describe the need for the Radioisotope Power Systems Facility.

Mr. Young. The original mission of the Radioisotope Power Systems Facility (RPSF) was to assemble and test radioisotope thermoelectric generators for an expected Air Force Program which would have required a large number of Plutonium 238 heat sources, and which could not be handled in the existing radioisotope power system facilities at the Mound Plant. When the Air Force Program was cancelled, the RPSF was continued as part of our infrastructure modernization program to provide the Department with a modern facility for assembling and testing radioisotope power sources, one that would meet all current safety, security, safeguards, health and environmental requirements, and be capable of operation to the year 2010 and beyond.

Mr. Bevill. What applications pace the development of the SP-100 space reactor and the Multimegawatt Special Power System?

Mr. Young. National Aeronautics and Space Administration applications of SP-100 power systems for the Human Exploration Initiative require a space-ready system near the turn of the century. The first application would likely be for Lunar surface power. SP-100 could also be used in this same time period on nuclear electric propulsion missions being considered for the outer planets. Potential military applications of SP-100 power technology for the Strategic Defense Initiative or the Air Force would need the system to be flight tested by the late 1990s.

The multimegawatt space reactor power systems were originally being developed as a potential power source for the later phases of SDI. However, if nuclear propulsion assessments currently underway at NASA are favorable, multimegawatt space reactor systems for nuclear propulsion could be required as early as the middle of the first decade of the next century for space demonstration of the technology for later manned Mars missions.

ADVANCED RADIOISOTOPE POWER SYSTEMS

Mr. Bevill. Describe the formal process used by the Department of Defense and NASA to establish a requirement for a nuclear power system.

Mr. Young. Requirements for nuclear systems evolve out of a review of either a particular mission or out of consideration of the projected needs of future missions. If the need for a nuclear system is identified, either for a near term mission or a category of future missions, the lead DOD or NASA organization will begin a dialogue with DOE. Initial studies are conducted either individually or jointly. When considering nuclear systems, most mission planners recognize that development times for nuclear power systems are usually longer than the development schedule for specific missions. Therefore, both mission and technology development activities are conducted by the user agencies and DOE, respectively. When the nuclear requirement becomes firm, interagency agreements and memoranda of understanding are signed at agency senior management levels.

Mr. Bevill. How is this requirement formally transmitted to the Department of Energy.

Mr. Young. The process steps may vary, but the overall requirements are basically established by the user agency as part of its mission planning function, and then presented to DOE for execution. The requirements are usually established in interagency agreements or memoranda of understanding (MOU's) between the agencies, which lay out each parties' responsibilities in a joint program. Detailed technical requirements are further established in technical specifications or functional or operating requirements that are developed by the users and agreed upon with the Department of Energy. In some of the technology areas jointly sponsored with SDIO, a less formal Work Package Description is used in addition to MOU's as the agreement document that establishes what is to be done on a year-to-year basis.

SPACE/DEFENSE POWER AND ADVANCED RADIOISOTOPE POWER SYSTEMS

Mr. Bevill. Please provide the requirements documents for all systems under development for DOD. Provide a list of all Space Reactor and Advanced Radioisotope Reactor concepts currently under consideration; include a description of each, the estimated total cost and development time.

Mr. Young. The table inserted for the record shows the major concepts.

Space Reactor Systems

Concept	Power Level	Description	Cost
SP-100 Space Reactor	10's to 100's of kWe	Fast lithium cooled reactor with a thermoelectric converter system	$851 million, through Ground Engineering System Test. Flight Test possible in the late 1990's.
Multimegawatt (MMW) Space Reactor (3 concepts being considered	10's to 100's of MWe	Concepts include: Open Gas Cycle and Closed Rankine, liquid-metal cooled systems. Pulse power for SDI requires energy storage for closed systems. Open systems use hydrogen for cooling	Concepts and requirements not sufficiently defined for costing or schedule definition for specific reactor system designs. Development program would continue to early 2000's.
Thermionic Fuel Element Verification (Converter Technology being developed)	For use from kWs to a few MWs	Alternate Converter Technology (Total System not under development)	Converter only costs will be around 50 million by mid 1990's.

Advanced Radioisotope Power Systems

Concept	Power Level	Description	Development Cost/Time
General Purpose Heat Source RTG	100's of watts	Operational RTG being used in NASA's Galileo and Ulysses missions and planned for use in CRAF and Cassini missions.	Concept already developed; mission-specific design and support activities underway for $13 million in FY 91
Modular RTG	100's of watts	Performance and safety improvements from General Purpose Heat Source RTG for space applications.	$27.8 million, operational in FY 1993
Terrestrial Prototype RTG	2 watts	Radioisotope thermoelectric generator with a thermoelectric converter system.	$5.7 million and 30 months.
Turbine Energy Conversion System	1 to 10 Kilowatts	A dynamic energy conversion system for space operations which employs a rotating turbine/alternator for conversion of heat to electricity, and uses the general purpose heat source developed for radioisotope thermoelectric generators.	No funds requested in FY 1991; to begin closeout in FY 1990. Program had included a Ground Demonstration System protype which would require $87 million and be operational in 1996.

Mr. Bevill. For each defense or space reactor concept, provide a summary of all cost-sharing arrangements made with other Federal agencies, other governments and private sector companies.

Mr. Young. The SP-100 and Multimegawatt Space Reactor are the current space reactor concepts. They are at two different stages of development. SP-100 is in the hardware development stage, whereas Multimegawatt is in the initial feasibility stage.

Cost sharing with other federal agencies for the SP-100 program is in the form of direct funding provided by NASA and the Department of Defense (Strategic Defense Initiative Organization) on an annual basis. In FY 90, SP-100 was provided $20 million by SDI and $10 million by NASA; it is planned that NASA and DOD will provide $20 million each in FY 1991. There has been no private sector cost sharing to date. Other governments have not shown an interest in participating in cost sharing in the SP-100 program.

The Multimegawatt program received funding from DOE and SDI in FY 1989. For FY 1990, the majority of program funding had been planned to come from SDIO, but recent cuts in the SDIO FY 1990 budget have, to date, precluded SDIO-funded multimegawatt program activities, including initiation of Phase II contracts, from proceeding. However, NASA has expressed an interest in these reactor systems for nuclear propulsion and

has requested by letter that the Department of Energy sign Phase II contracts and use the balance of its existing FY 1989 carryover MMW funding to initiate more detailed nuclear propulsion assessments and studies. If the results of these assessments prove favorable, NASA may continue some of the multimegawatt propulsion-related contractor activities in FY 1991 and later. If the multimegawatt space reactor program is continued by SDIO or NASA, DOE will continue to manage the program, as it has in the past. Since a system developer has not yet been chosen, there are no private sector cost sharing arrangements. The potential for cost sharing arrangements with other governments cannot be evaluated until after concept selection has taken place.

Thermionic Fuel Element Verification is an ongoing power conversion development program to verify thermionic technology. Funding for this activity is shared by DOE and the Strategic Defense Initiative Organization.

U.S. URANIUM ENRICHMENT CORPORATION

Mr. Bevill. The President's budget assumes the submission of legislation to provide for the privatization of the Uranium Enrichment enterprise. Please describe the legislation including the costs and benefits.

Mr. Young. The legislation that the Administration has proposed, as embodied in H.R. 2480, would create a wholly Government-owned enrichment corporation, not a private one. This corporation would have the mandate and necessary flexibilities to succeed in today's fiercely competitive international enrichment market.

No costs will be incurred by the Federal Government by enacting legislation to create a Government corporation. The corporation would be self-financing without the need for appropriations. It would rely on its own resources for financing, not on those of the Federal Government.

The benefits of the Administration's proposal would be substantial. By giving the corporation the same operational flexibilities as a private business, it will have the ability it presently lacks to remain competitive in today's international market. The monetary value of this will be reflected directly in the dividends it will return to Treasury. The legislation also provides for the establishment of a fund in Treasury that will ensure that the necessary amounts are available when needed for the decontamination and decommissioning of enrichment facilities. This future cost avoidance represents a major benefit. As the more businesslike

corporation establishes a successful track record, its value will increase. This maximization of value would give the taxpayers the best chance of recovering their investment in enrichment through the payment of dividends by the Government corporation and the eventual proceeds from a sales transfer to the private sector.

A detailed treatment of the major elements of H.R. 2480, comparing its approach to that of S. 83, passed by the Senate last July, is shown in a table that I would like to insert in the record. (The information follows:)

COMPARISON OF LEGISLATION BY MAJOR ELEMENT

Issue	H.R.2480 (Administration Proposal)	S.83
Title I (Uranium Enrichment)		
Administrator/Board of Directors	Managing Board of Directors with Members Appointed by President & Confirmed by Senate & Serving at the Pleasure of President; CEO appointed by Board	Advisory Board of Directors Appointed by President; Administrator, Responsible for All Aspects of Operations, Appointed by President & Confirmed by Senate for a 6 year term. Can only be removed for negligence or malfeasance in office.
Initial Debt	$364M; Pay Interest Annually; Pay 1/2 Principal by 1994 & Balance by 1999	$364M; Repayment 20 Yrs.
D&D	Fund Established to Pay for Commercial Share of D&D at All Enrichment Sites; Commercial/Federal Responsibility Based on Prior Deliveries; $50M/Yr Fund Payment Schedule Specified.	Fund Established to Pay for Commercial Share of D&D at All Enrichment Sites; Commercial/Federal Responsibility Based on Prior Deliveries; Fund Payment Schedule Developed by Corp, but 50% Must be Paid by 2000.

Issue	H.R.2480 (Administration Proposal)	S.83
Privatization	Establishes Gov't Corp; Requires Privatization Study in 3 Yrs; After 5 Yrs can Privatize Without Congressional Action by Sale of Corp (1-Step)	Establishes Gov't Corp; Requires Interim Privatization Study in 3 Yrs & Final Report in 5 Yrs; Congress Must Pass New Legislation before Sale of Corp (2-Step)
NRC Licensing	Initially Exempt; NRC to Develop Regs within 2 Yrs; Corp Applies for License 1 Yr Later; NRC Must Make Licensing Decision on GDPs No Later than 5 Yrs; New Plants Must be Licensed; DOE Retains ES&H Oversight Until Licensed	Initially Exempt; NRC to Issue Regs for Licensing within 2 Yrs; Corp to Apply for License within 1 Yr Thereafter; No Mandated Decision Date by NRC; New Plants Must be Licensed; DOE Retains ES&H Oversight Until Licensed
Borrowing Authority	$2.5B; No access to Federal Financing Bank	$2.5B; No Access to Federal Financing Bank
Equity	Gov't Owns Stock; Initial Stock Value Set at $3B; Dividends Paid to Treasury Out of Surplus; Treasury to Receive Proceeds from Eventual Sale of Corp if Recommended by Corp & Approved by President	Gov't Owns Stock; Dividends Paid to Treasury Out of Surplus; Treasury to Receive Proceeds from Eventual Sale of Corp if Approved by Congress
Pricing Commercial	Recover Costs & Generate Profit if Possible	Recover Costs & Generate Profit if Possible

Issue	H.R.2480 (Administration Proposal)	S.83
Gov't	Recover Costs Exclusive of Profit; Price Shall Not Exceed the Lower of Cost or Average Commercial Price for Low Assay Enrichment	Recover Costs Exclusive of Profit; Includes D&D; Cost Recovery Price Shall Not Exceed the Average Commercial Price
Price-Anderson	Corp & Its Contractors Shall Be Treated by NRC as Licensees	Corp Has Same Authority to Fully or Partially Indemnify its Contractors as DOE has Today, but Once Licensed by NRC, Corp Shall be Treated as a Licensee
Federal & State Taxes	No Federal Income Taxes; Payments in Lieu of Local Tax	No Federal Income Taxes; Payments in Lieu of Local Tax
Budget	Exempt from Appropriations & Gramm-Rudman-Hallings	Exempt from Appropriations & Apportionment
OSHA, EPA, Etc.	Must Comply	Must Comply
Instrumentality of U.S.	Specifically Designated as an Instrumentality of the U.S.	Specifically Designated as an Instrumentality of the U.S.
Section 161(v) of the Atomic Energy Act of 1954	Repeals Existing Legislation Concerning Uranium Enrichment: Pricing, Contracting & Limited Protection for U.S. Miners, etc.	Repeals Existing Legislation Concerning Uranium Enrichment: Pricing, Contracting & Limited Protection for U.S. Miners, etc.
Assets Transferred GDPs	Paducah & Portsmouth (Including Top) Transfer to Corp; Oak Ridge Remains with DOE	Paducah & Portsmouth (Including Top) Transfer to Corp; Oak Ridge Remains with DOE Until D&D is Performed

Issue	H.R.2480 (Administration Proposal)	S.83
AVLIS	AVLIS Facilities & Equipment Used Exclusively for Uranium Enrichment Technology Development Transfer to the Corp (Covers Only the Uranium Separator). Corp has Exclusive Right To Deploy or License AVLIS	Rights to AVLIS Transfer to Corp
Natural Uranium Stockpile	All Uranium Transfers to Corp Except Uranium Allocated to Meet Defense Needs	All Uranium Transfers to Corp Except Uranium Allocated to Meet Defense Needs
High Assay Stocks	Remains with DOE	Remains with DOE
R&D	Sec'y Will Conduct R&D as Requested by the Corp	Sec'y Will Conduct R&D as Requested by the Corp
Employees	Federal with Pay Cap; No Pay Cap for CEO & Corporate Officers	Federal with Pay Cap, Except for Top 10 Corporate Officials

Issue	H.R.2480 (Administration Proposal)	S.83
Title II, Subtitle B (Uranium Revitalization)	Provisions Not Included	Voluntary Overfeed Program; Nat'l Strategic Uranium Reserve; Sec'y Responsible for Industry; Gov't Uranium Purchase
Title II, Subtitle A (Uranium Security and Tailings Reclamation)	Provisions Not Included	Max. $270M to Active Uranium Site Licensees; Max. $30M to Active Thorium Site Licensees; Indexed for Inflation

Mr. Bevill. What does the Administration propose to request of the Appropriations Committee if the legislation is not enacted in a timely fashion?

Mr. Young. If the proposed legislation is not enacted in a timely fashion, the Administration would request that the Committee approve an appropriation of $1,406,018,000 for all ongoing enrichment activities that are not dependent on the proposed legislation. In addition, the Administration would request that the Committee approve appropriation language to allow transfer of $50,000,000 of FY 1991 revenue collections to a Decontamination and Decommissioning Fund in the Treasury. We would not request budget authority of $29 million, for the interest payment on the proposed $364 million debt, or $45.5 million for dividends/working capital.

GASEOUS DIFFUSION BUDGET

Mr. Bevill. Please describe the significant increase in FY 1991 funding for non-power Diffusion Operations.

Mr. Young. The Diffusion Operations category includes funding for plant operations, maintenance services, analytical services, and other production support activities. In FY 1991, the Diffusion Operations budget request totals $213.3 million, an increase of $25.3 million over the funding level in FY 1990 of $188.0 million.

The increase in costs for FY 1991 are primarily related to an increased emphasis on a higher standard of conduct of operations regarding environmental and safety matters. This requires greater resources for highly skilled and trained personnel at all levels and higher costs to ensure operations continue to be conducted in the safest and most environmentally sound manner possible. Specifically, about one-third of the increase from FY 1990 to FY 1991 is due to escalation. The remaining increases are due to additional manpower required to update safety analysis and operational safety reports, enhanced training programs through additional accreditation, increased operational safety and contamination control, and improvements we are implementing in the quality of operations and maintenance at our production facilities. Additional manpower is also needed for cleaning up and removing hazardous materials, additional laboratory, technical and administrative support, and upgrading computer software. Finally, additional funds are needed to repair the roads on the sites and the water tower at Portsmouth.

INVENTORIES

Mr. Bevill. Describe the impact of eliminating the SWU inventory has had on the operation of the Uranium Enrichment enterprise.

Mr. Young. The primary impact of eliminating the excess SWU inventory is it requires the Department to budget for and produce essentially the same quantity of SWU as will be sold and delivered in a fiscal year. A precise quantity of SWU sales that must be delivered in any fiscal year is not known until mid-April or less than 6 months before the fiscal year ends. The budget for power and operations to support the production necessary to match this sales level is established 12 to 18 months earlier than the date when the actual sales quantity is known. Without an excess SWU inventory, careful planning is required to ensure that sufficient monies are available to support production at the level necessary to match actual sales requirements.

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U.S. URANIUM ENRICHMENT CORPORATION

Mr. Bevill: Describe in some detail the organization and proposed funding mechanisms for the U.S. Uranium Enrichment Corporation.

Mr. Young: The Administration's proposed legislation would establish a wholly Government-owned corporation operated by a Chief Executive Officer who is experienced in managing and leading successful corporations and who would act under the direction of a five-person board of directors appointed by the President. The corporation would be able to set prices competitively, borrow money from commercial sources, and be free of restraints of the Government budget process. Organized in this manner, the corporation would be managed by appointed officials who would ensure that its operations and plans will be in the best interests of the United States.

Under the bill, the Secretary of Energy would transfer to the corporation all enrichment-related assets and functions needed to provide enrichment services at the Paducah, Kentucky, and Portsmouth, Ohio, plants. Provision would be made for licensing, decontamination and decommissioning, and remedial action of all of the enrichment plants.

The corporation would be required to make annual payments to the Treasury for interest on an initial debt of $364 million and establish a fund in the Treasury to cover future expenditures for decontamination and decommissioning of the enrichment plants. The corporation would also provide dividends to the Treasury on Government-held stock.

REVENUES

Mr. Bevill. Please describe the increase in revenues in FY 1991.

Mr. Young. The projected revenues in the FY 1991 congressional budget are $1.530 billion, which is $113 million higher than the revenue amount expected FY 1990. The increase is related primarily to a higher SWU price and a slight increase in expected commercial sales.

ENVIRONMENTAL, SAFETY AND HEALTH

Mr. Bevill. Provide the funding for environmental programs funded by Uranium Enrichment in FY 1989, FY 1990, and FY 1991.

Mr. Young. The majority of the environmental funding for the uranium enrichment program are identified in the DOE Environmental Restoration and Waste Management Five Year Plan. The funding is subdivided into the three areas of Corrective Actions, Environmental Restoration, and Waste Management.

Corrective Actions are those activities necessary to correct noncompliance with environmental regulations. Environmental Restoration includes those actions necessary to cleanup environmental contamination caused by past operations. Waste Management includes those actions necessary to handle, store, treat, and dispose of wastes generated at the uranium enrichment facilities according to environmental laws and regulations.

In addition to these programs, part of the gaseous diffusion operating budget at each plant is associated with activities to monitor and ensure that conditions at the plant remain in compliance with all environmental laws and regulations. These activities include ongoing site-wide compliance monitoring including air, surface water and groundwater, costs of an environmental management staff, development and submission of reports

to the State and Federal environmental departments, and other base costs. The funding for uranium enrichment environmental programs is shown in a table I would like to insert in the record. (The information follows:)

URANIUM ENRICHMENT ENVIRONMENTAL FUNDING
(IN THOUSANDS OF DOLLARS)

	FY 1989	FY 1990	FY 1991
Corrective Actions.....	$ 4,601	$ 7,537	$ 9,250
Environmental Restoration.....	46,180	58,426	67,419
Waste Management.....	9,333	13,714	13,949
Subtotal, Five-Year Plan...	$60,114	$79,677	$ 90,618
Environmental Activities included in Gaseous Diffusion Operating Budget.....	14,900	15,400	15,700
Total, Environmental.....	$75,014	$95,077	$106,318

AGREEMENT WITH THE TENNESSEE VALLEY AUTHORITY

Mr. Bevill. Describe the status of the agreement with TVA to reimburse for power not consumed.

Mr. Young. On December 18, 1987, the Department and TVA signed an agreement under which the Department would make payments to TVA as shown in a table which I would like to insert in the record. (The information follows:)

DEPARTMENT OF ENERGY PAYMENTS TO THE TENNESSEE VALLEY AUTHORITY
(DOLLARS IN MILLIONS)

Due Date	Settlement Amount
January 1, 1988 (FY 1988)	$ 448
October 1, 1988 (FY 1989)	465
October 1, 1989 (FY 1990)	311
October 1, 1990 (FY 1991)	160
October 1, 1991 (FY 1992)	160
October 1, 1992 (FY 1993)	160
March 6, 1994 (FY 1994)	160
	$1,864

The payments for fiscal years 1988 through 1990 have been made. Funds to permit the October 1, 1990, payment to be made have been included in the Department's FY 1991 budget request.

U.S. URANIUM ENRICHMENT CORPORATION

Mr. Bevill. Please describe how the Nation's best interest would be served by the conversion of the Uranium Enrichment program to a Government corporation.

Mr. Young. We believe that establishing a Government corporation for uranium enrichment will best sustain a financially healthy, competitive enterprise that can maximize return on investment to the taxpayer. An enrichment corporation would possess commercial flexibilities necessary to operate effectively in the competitive marketplace and secure a sales base that would optimize future earnings. This is expected to result in a more cost efficient business that economically meets the nuclear fuel needs associated with 20 percent of the Nation's generation of electrical power. A strong, competitive U.S. enrichment business would also enhance the Nation's trade balance by ensuring more than $500 million in foreign sales.

Mr. Bevill. What is the Administration's best estimate of the value of the enrichment enterprise?

Mr. Young. The true test of value is what a buyer is willing to pay. In the business world, purchase decisions are based in a large part on future earnings potential. We believe that the future earnings potential of the enrichment enterprise would be enhanced by establishing a government corporation. Hence we expect that its value will increase if a government corporation is established because it will be equipped with commercial characteristics and therefore more able to effectively operate in a highly competitive market place.

Mr. Bevill. What specific protections are necessary to assure a supply of enriched materials for national defense requirements?

Mr. Young. The legislation proposed by the Administration recognizes that the corporation would play a critical role in providing enrichment services necessary for the nuclear naval propulsion program and other defense-related purposes. As a reaffirmation of the Atomic Energy Act, the legislation establishes the Nation's common defense and security as a paramount objective of the corporation.

U.S. URANIUM ENRICHMENT CORPORATION

Mr. Bevill. Does the Administration consider the establishment of a Government corporation for the operation of the Uranium Enrichment enterprise to be the ultimate privatization of the enterprise?

Mr. Young. Philosophically, the Administration believes that the services provided by the enterprise are so predominantly commercial that it properly belongs in the private sector. As a practical matter, we believe that the corporation will not be a serious candidate for privatization until it establishes a successful track record. Only then would the Government be able to recover its investment in enrichment by selling the enterprise at its book value or better. Consequently, the Administration recognizes that privatization must await a period of successful commercial operation as a Government corporation.

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DIVIDENDS/WORKING CAPITAL

Mr. Bevill. Describe your budget category Dividends/Working Capital. If legislation is not enacted establishing a Government corporation, how would these funds be utilized?

Mr. Young. The Dividends/Working Capital budget category represents the amount of revenues that exceed budget authority requested for programmatic requirements and for the proposed payment to the Treasury.

Legislation submitted by the Administration to Congress on April 18, 1989, to create a U.S. Uranium Enrichment Corporation, when enacted, would require the Corporation to pay dividends to the Treasury, to the extent that revenues are not needed for program requirements or working capital. Until legislation is enacted, no distribution of these excess funds is proposed.

If legislation is not enacted, these funds, or excess revenues, would remain in the uranium enrichment special receipt account in Treasury.

DECONTAMINATION AND DECOMMISSIONING FUND

Mr. Bevill. Describe the proposed decontamination and decommissioning fund.

Mr. Young. The Administration is proposing through legislation to establish an interest bearing fund in the U.S. Treasury to cover the commercial share of future decontamination and decommissioning (D&D) costs. Annual deposits of $50 million would be made. We estimate that deposits at that rate with interest will grow to about $1.5 billion in 2005. This would then provide adequate funds to meet the commercial share of the estimated total cost of $3 billion to D&D the three uranium plants.

If legislation creating a government corporation for uranium enrichment is not enacted, the Administration is also proposing appropriation language that would establish a D&D fund in Treasury with $50 million being transferred there from uranium enrichment revenues in FY 1991.

REVENUES

Mr. Bevill. What authority exists for the Department to collect and apply its revenues to Decontamination and Decommissioning activities?

Mr. Young. Decontamination and Decommissioning, D&D, of the uranium enrichment plants is a cost of providing enrichment services and under current law must be recovered in the charge to customers. Generally accepted accounting practices require that these costs be recognized today even though the actual expenditures of monies will not occur until some future date. Since the Department does not currently have the authority to apply enrichment revenues into a D&D fund, the FY 1991 uranium enrichment budget requests congressional approval to establish such a fund.

REVENUES

Mr. Bevill. If legislation is not enacted concerning the collection and use of Decontamination and Decommissioning funds, how will the budgeted revenues be utilized?

Mr. Young. If legislation is not enacted concerning the collection and use of Decontamination and Decommissioning funds, any budget revenues, in excess of appropriated budget authority, would remain in the uranium enrichment special receipt account in Treasury.

POWER COST

Mr. Bevill. Describe your program to utilize low-cost firm power in the diffusion facilities.

Mr. Young. Historically, the gaseous diffusion plants have relied exclusively on firm power contracts. The new power strategy, with its reliance on the use of both low cost firm and non-firm power, will minimize the gaseous diffusion plants power costs and reduce the potential liabilities associated with long-term, firm power contracts.

The power strategy is based on three elements. First, negotiation of contract extensions with Electric Energy, Inc. and the Ohio Valley Electric Corporation to supply low-cost, firm power to Paducah and Portsmouth, respectively. The contract extension with Electric Energy, Inc. has been completed and became effective in FY 1987. We expect to complete negotiations with the Ohio Valley Electric Corporation in late FY 1990 or early FY 1991. These two contracts will supply about 70 percent of DOE's power requirements. Second, utilization of non-firm power, instead of more expensive firm power, whenever it is available, from multiple utilities on a seasonal, weekly, and hourly basis to satisfy the remaining 30 percent of DOE's power requirements. And third, making capital investments at the Paducah plant and, to a lesser degree, at the Portsmouth plant to enable the plants to rapidly alter their power levels to allow them to utilize non-firm power.

As a result, the Paducah plant and, to a much smaller degree, the Portsmouth plant, will become "swing" customers, able and willing to buy large amounts of low cost electric power on short notice.

GASEOUS DIFFUSION BUDGET

Mr. Bevill. Even though the power cost for operating gaseous diffusion plants is the dominant expense, please provide how the non-power operating expenses have changed in recent years.

Mr. Yourg. The non-power operating cost for fiscal years 1989, 1990, and 1991 are $304 million, $391 million and $444 million, respectively. These costs include funding for all non-power activities included in the Gaseous Diffusion Operations and Support, Corrective Actions, Environmental Restoration, and Waste Management program activities, including capital equipment and construction. Increases from FY 1989 to FY 1991 are primarily associated with cost escalation, additional manpower needed to operate the gaseous diffusion plants at increased power levels, and additional resources required for environmental, health, and safety activities needed to ensure the highest level possible for conduct of operations on an environmentally responsible basis.

GASEOUS DIFFUSION BUDGET

Mr. Bevill. Please estimate the non-power operating costs for the coming decade.

Mr. Young. An estimate of the non-power operating costs for FY 1991 through FY 2001, in constant FY 1991 dollars, are shown in a table which I would like to insert in the record. These costs include the funding for all non-power activities included in the Gaseous Diffusion Operations and Support, Corrective Actions, Environmental Restoration, and Waste Management program activities, including capital equipment and construction. The projected reduction in costs in the years after FY 1995 assumes that many of the Corrective Action, Environmental Restoration, and Waste Management activities initiated in the early years will have been completed or phasing down. (The information follows:)

NON-POWER OPERATING COSTS
(IN MILLIONS OF DOLLARS)

Fiscal Year	Costs
1991	444
1992	516
1993	527
1994	531
1995	522
1996	465
1997	430
1998	410
1999	395
2000	385
2001	375

PRICING

Mr. Bevill. What impact is the non-power operating costs expected to have on future SWU prices?

Mr. Young. There have been significant increases in the non-power gaseous diffusion plant operating costs over the last 2 years. These increases will put upward pressures on our price. However, we are optimistic that reductions in power costs relating to non-firm power purchases and reduced payments to TVA for power not purchased will avoid the need for price increases.

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REPAYMENT OF INVESTMENT

Mr. Bevill. Describe the current proposal to require repayment of investments in the enrichment enterprise.

Mr. Young. The unrecovered Government investment in the uranium enrichment enterprise was $2.960 billion on September 30, 1989. Prices charged for enrichment services will recover the investment as plant and equipment is depreciated and inventories are sold. Our proposed legislation to establish an enrichment corporation, H.R. 2480, will provide for compensation for the Government's investment in enrichment through payments on an initial debt of $364 million plus interest, dividends on Government-owned stock, and the proceeds from future sale of stock if authorized.

REPAYMENT OF INVESTMENT

Mr. Bevill. What is the current estimate of this "debt" to the Treasury of the Uranium Enrichment enterprise?

Mr. Young: The Treasury has never issued a "debt" instrument for enrichment related activities. Current law and the enrichment services criteria do require, however, that the unrecovered Government investment be recovered in prices charged to customers over time. The Department has reported this investment to be $2.960 billion as of September 30, 1989. This amount reflects the 1985 decision to write down $4.1 billion of unproductive assets in accordance with generally accepted accounting practices and prudent business actions.

REPAYMENT OF INVESTMENT

Mr. Bevill. What are the proposed procedures for the reimbursement of the "debt"?

Mr. Young. Under current law there is no "debt" and therefore, there are no procedures for its recovery. Under our proposed legislation, H.R. 2480, an initial debt of $364 million is established. Interest on this debt is to be paid annually and at least one half of the principal will be paid by September 30, 1994, with the balance due no later than September 30, 1999.

REPAYMENT OF INVESTMENT

Mr. Bevill. The Continuing Resolution for FY 1987 provides that the amount of unrecouped costs that must be returned to the Treasury by the enrichment program shall be determined by Congress in future legislation. Does the Department agree that until Congress establishes this amount in legislation, the Department does not have the authority to collect and return to the Treasury amounts relating to prior unrecouped costs? If you do not agree, cite the legal authority that supports the Department's position.

Mr. Young. We agree that the FY 1987 Continuing Resolution provides that the amount of unrecouped costs or unrecovered Government investment that must be returned to the Treasury by the enrichment program will be determined by Congress in future legislation. Until Congress acts to establish the amount of this unrecovered Government investment, however, DOE will continue to apply its traditional pricing methodology to amortize the unrecovered Government investment, as required under the Atomic Energy Act.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Bevill. Describe the status of the laser isotope separation process including any changes in the schedule for completion.

Mr. Young. The technology is in the research and development phase and ready to begin final full-scale integration of all important subsystems for full-scale demonstration of process performance. Specifically, to reach our full-scale demonstration goals, we must increase laser chain power and separator run time by about 50 percent. With the additional laser power, we expect to increase enrichment performance by a factor of 10. In the area of uranium processing, we expect to move from bench scale to engineering scale, about a factor of 10 increase in uranium throughput. The schedule for completion of the demonstration is now the end of FY 1992. This represents a 9 month delay in the schedule as presented last year. This delay is the result of Congress appropriating less than the Administration request and an increase in the scope of the demonstration.

A significant difference between the 1989 U-AVLIS program plan and the 1990 plan is the level of technical demonstration. A common building block for the U-AVLIS process is the separator pod. The 1989 plan was based on the operation of a single separator pod and a single advanced laser chain by the end of 1991. The Secretarial-approved plan is based on the operation of multiple separator pods and multiple advanced laser chains which significantly reduces the possible technical and economic risks of proceeding to a production plant.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Bevill. What actions will be taken to ensure that the deployment of AVLIS is not a repeat of the GCEP experience?

Mr. Young. The Department intends to apply a disciplined approach consistent with principles used in the private sector. This approach involves identifying a design with proven technical and economic performance, minimizing the capital investment of a deployment venture, and involving industrial knowledge and expertise in the process of deployment. These types of actions are highlighted in the AVLIS plan that was submitted to Congress on January 19, 1990.

Specifically, the Department will deploy the AVLIS technology only when the technical and economic performance are demonstrated at plant scale conditions. A technology demonstration will be completed by September 1992, at which time the demonstration results will be thoroughly evaluated for the purpose of making a deployment decision by November 1992. Steps will also be taken to assure that deployment is warranted and consistent with market needs. In addition to internal market assessments, the Department plans to seek the advice and input of a senior industrial review group with extensive experience in the industrial sector, the nuclear industry, and in high technology programs. Finally, additional industrial involvement will be incorporated to the maximum extent possible. This involvement will include the industrial participation program beginning in 1990, leading to the eventual selection of a commercial deployment contractor that will be used to facilitate a successful transition to deployment of the AVLIS technology. At all times, the business, financial, and commercial principles associated with deployment decisions in the private sector will be utilized and applied in the AVLIS program.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Bevill. Describe your program to permit access by industry to classified AVLIS technology.

Mr. Young. We intend to initiate an Industrial Access (IA) program by August 1990 which would provide access to industrial firms to receive access to classified Uranium-Atomic Vapor Laser Isotope Separation, U-AVLIS, technology by amending 10 CFR 725. Industrial firms who chose to participate in this program would be required to pay a permit fee, have appropriate security clearances, and provide DOE, when required, with independent reviews of the U-AVLIS program, including evaluation of demonstration activities, transition plans, cost estimates, financing alternatives, capital venture schemes, deployment options, etc. The intent is to augment existing mechanisms by which value can be added to the program from the input of industrial expertise in return for the potential value provided to industrial firms from their access to the U-AVLIS technology.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Bevill. Describe the safeguards anticipated to protect the Nation's security interest in granting industry access to AVLIS technology.

Mr. Young. All contracts with the Industrial Access (IA) program participants will define conditions on access in order to protect the public interest and the common defense and security. Our rulemaking Federal Register notice will indicate that among the factors to be considered by DOE in selection are the interests of the U.S. ratepayers and taxpayers who financed the development of the Uranium-Atomic Vapor Laser Isotope Separation, U-AVLIS, technology, as well as our scrutiny of foreign ownership in the private sector entity requesting access to determine safeguard risk.

Furthermore, the IA program will be conducted in a manner that ensures all conditions currently covered by U.S. laws to protect the U-AVLIS technology will be fully met. For example, present law permits DOE to deny access to the U-AVLIS technology under any or all of the following conditions: any corporation not organized under the laws of the United States or a political subdivision; any individual not a U.S. citizen; any partnership where one or more partners are not U.S. citizens; any unincorporated association where one or more persons are not U.S. citizens; any organization owned, controlled, or dominated by the Government of, a citizen of, or an organization listed as a Subgroup A country, 15 CFR 371.3; and any person subject to the jurisdiction of the United States who is not doing business within the United States.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Bevill. Describe the establishment of the Senior Industrial Review Group and what this group will bring to the program.

Mr. Young. The Senior Industrial Review Group has been established to provide an independent assessment of the Uranium-Atomic Vapor Laser Isotope Separation, U-AVLIS, plan from a business and market prospective. The members of the group are: James E. Leiss, Consultant; Joseph Farley, Senior Executive Vice President, Nuclear, Southern Company Services; Edward Kintner, Executive Vice President, GPU Nuclear; John Segall, Vice Chairman, Contel; and Paul Low, President, General Product Division, IBM. This group will review the technology demonstration program, the transition program, and deployment alternatives. It will provide advice regarding the merits of planned demonstration activities, the relevancy of these activities in answering questions needed to be able to make a deployment decision, and the confidence of cost estimates based upon demonstration data that will be generated. In addition, the group will evaluate the steps proposed for the transition of the technology to the marketplace in terms of whether these steps can be expected to provide a successful result.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Bevill. For several years, DOE Uranium Enrichment has emphasized the need and its intent to become more business-like. What type of contractual arrangement will be implemented to assure a business-like deployment organization for AVLIS?

Mr. Young. The best assurance that Uranium-Atomic Vapor Laser Isotope Separation, U-AVLIS, technology will be deployed by a businesslike organization would be the creation of a Government-owned enrichment corporation, which would have the mandate and the ability to deploy AVLIS to the greatest commercial advantage.

Regardless of whether restructuring legislation is enacted, assurance of a businesslike deployment organization will be a matter of careful attention and close consultation with the business experts the Department will engage to advise on the transition process. The selection of a Commercial Deployment Contractor (CDC) will depend strongly on that organization's qualifications including: demonstrated capability in commercial operations, experience in the development of high technology processes, and successful application of advance technologies along with strong entrepreneurial experience.

The "Plan for the Demonstration, Transition, and Deployment of U-AVLIS Technology" establishes guidelines to ensure that the CDC will be responsible and accountable for the successful transition from the laboratory to production. The plan also requires input from business

advisors and consultants, from the Senior Industrial Review Group, from major industrial participants, architectural and engineering firms, construction managers, and other support and service contractors. Additionally, the CDC is required to produce thorough commercial assessments of the technology and associated market risks, based on, among other things, market research, evaluations of financial alternatives, and new venture-type economic analyses.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Bevill. What specific management actions will DOE take to assure that the transition of the AVLIS technology from the Laboratory to the plant will be accomplished in a manner that maintains the core people and skills critical for its success?

Mr. Young. The "Plan for the Demonstration, Transition, and Deployment of U-AVLIS Technology" requires the continued involvement of Lawrence Livermore National Laboratory, LLNL, and Martin Marietta Energy Systems, MMES, through the transition and deployment processes.

During transition, the Commercial Deployment Contractor, CDC, will be required to work closely with LLNL after selection and also after any transfer of program responsibility. In effecting the transfer, LLNL will retain responsibility for technical decisions. As subsystems are turned over to the CDC, LLNL will participate in all decisions that affect changes in the design of each subsystem. LLNL is charged jointly with the CDC to make recommendations to the Department.

During deployment, the Plan requires LLNL and MMES to continue staffing the development and demonstration program office, with LLNL as the lead organization. This office will be responsible for improving technology performance, increasing reliability and reducing costs; participating in plant construction, and providing continuing technical support to the architect-engineer and constructor.

Mr. Bevill. Are there any potential technical show stoppers in the AVLIS program that you are aware of at this time?

Mr. Young. To my knowledge, there are no technical show stoppers.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Bevill. What is the expected date that a commercial scale AVLIS enrichment facility will be built?

Mr. Young. The decision regarding deployment and therefore whether to proceed with construction of a Uranium-Atomic Vapor Laser Isotope Separation (U-AVLIS) enrichment facility is scheduled for November 1992. Based upon a positive deployment decision at that time, we would estimate that the first increment of production from a commercial scale U-AVLIS enrichment facility could go on line as early as January 1997.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Bevill. What is the expected interest in this development from the private sector?

Mr. Young. The AVLIS technology offers significant promise and benefit to the Department's enrichment enterprise. Interest by the private sector in the program has been high with an expressed view that investment by the private sector may be warranted when the promise of this technology has been more fully defined.

The AVLIS program has now reached the stage where additional private sector involvement in the development program can be very meaningful. Therefore, the Department intends to implement an industrial participation program in 1990 whereby industrial firms can obtain access and knowledge in the AVLIS program and then provide advice regarding the development, demonstration, and plans for transition to commercial application. Also, a commercial deployment contractor will be competitively selected in 1992 to facilitate the deployment transition. The Department expects private sector interest to be high both in the industrial participation program and during the selection of a deployment contractor.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Bevill. How much has the United States invested in laser isotope separation technology to date?

Mr. Young. From the inception of research in 1971 through FY 1989, $817 million has been expended on the Uranium-Atomic Vapor Laser Isotope Separation (U-AVLIS) technology.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Bevill. What would be the SWU cost of material enriched in an AVLIS plant?

Mr. Young. Our goal is to achieve an enrichment factory cost of between $25 and $50 per SWU. This range represents various plant sizes and plant operational modes. Capital cost estimates are based upon the amortization of plant capital and required technical support subsequent to a decision to deploy Uranium-Atomic Vapor Laser Isotope Separation. Operating costs are based upon mature steady-state operations.

Mr. Bevill. How does this compare to the current production SWU cost?

Mr. Young. The estimated average production cost from the gaseous diffusion plants for FY 1991 and beyond is projected to be about $70 per SWU in the absence of acid rain legislation. Based upon current acid rain legislation proposals, the average production cost could increase to about $90 per SWU by the year 2000.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Bevill. What is the best estimate of the current cost of an AVLIS production plant?

Mr. Young. The recent January "Plan for the Demonstration, Transition and Deployment of U-AVLIS Technology" documented the estimated capital cost for a nominal 3, 6, and 9 million SWU plant. Those capital costs were about $600, $860, and $1030 million, respectively.

REVENUES

Mr. Bevill. What is the principal reason for the increase in revenues from the commercial reactor sector?

Mr. Young. Revenues from the commercial sector have increased from $1.231 billion in FY 1990 to $1.338 billion in FY 1991, an increase of 8.7 percent. The principal reason for the increase is an increase in the SWU price and a slight increase in sales volume.

REVENUES

Mr. Bevill. What is the primary reason for the increase in revenues from the Government?

Mr. Young. Revenues from the Government have increased from $186.4 million in FY 1990 to $192.8 million in FY 1991, an increase of $6.4 million or 3 percent. This increase occurs despite a reduction of about 20 percent in Government requirements. Increased Government revenues in FY 1991 are due to substantially higher environmental costs that are related to the production of highly enriched uranium for Government customers.

REVENUES

Mr. Bevill. In accordance with the provisions of the Energy Reorganization Act of 1974 and the FY 1987 Continuing Resolution, FY 1987 uranium enrichment revenues can only be used for uranium enrichment purposes. How do you plan to utilize any revenues in excess of enrichment costs that may be received in FY 1991?

Mr. Young. You are correct in stating that enrichment revenues can only be used for enrichment purposes. If, in FY 1991, revenue collections exceed actual costs and outlays, the excess would be retained in the uranium enrichment special receipt account in the U.S. Treasury. The proposed legislation to establish an enrichment corporation includes a provision that would transfer any excess enrichment revenues to the corporation to provide initial working capital. Further, the legislation specifies that any revenues in excess of working capital requirements could be returned to the Treasury as a dividend.

REVENUES

Mr. Bevill. If the Congress uses similar appropriation language again in FY 1991 for the enrichment program, how would you utilize any excess enrichment revenues that may be received in FY 1991?

Mr. Young. If actual uranium enrichment revenue collections were to exceed appropriated budget authority, the excess would be retained in the uranium enrichment special receipt account in the U.S. Treasury. The proposed legislation to establish an enrichment corporation includes a provision that would transfer any excess enrichment revenues to the corporation to provide initial working capital. Any revenues above working capital requirements could be returned to the Treasury as a dividend.

MARKET SHARE

Mr. Bevill. What is the current U.S. share of the domestic and world enriched uranium market?

Mr. Young. In 1990, DOE will supply about 48 percent of the world enrichment market. About 92 percent of domestic fuel requirements will be met with enriched uranium supplied by DOE.

MARKET SHARE

Mr. Bevill. How does this compare with 5 years ago? 10 years ago? Provide a table showing the U.S. share for each of the last 10 years.

Mr. Young. The U.S. share of the domestic and free world market for enriched uranium over the last 10 years is shown in a table that I would like to insert in the record. (The information follows:)

U.S. MARKET SHARE FOR ENRICHED URANIUM (1980-1990)

Fiscal Year	Percent of Free World Market	Percent of Domestic Market*
1980	55	100
1981	54	100
1982	57	100
1983	68	95
1984	55	87
1985	47	76
1986	46	85
1987	50	85
1988	44	88
1989	46	94
1990	48	92

*Excludes use of excess U.S.-origin inventories that are being used.

ISOTOPE PRODUCTION AND DISTRIBUTION

Mr. Bevill. Describe the Isotope Production Program.

Mr. Young. The production, supply, and sale of isotopes and related services originating in the Department of Energy (DOE) production and research facilities have been long-standing elements of the DOE program. The authority for this activity is derived from specific provisions in the Atomic Energy Act of 1954.

Stable isotopes and radioisotopes together with related services are now being produced in DOE production and research facilities which presently include: Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), EG&G Mound (Mound), Idaho National Engineering Laboratory (INEL), Los Alamos National Laboratory (LANL), Oak Ridge National Laboratory (ORNL), Westinghouse Hanford Company (WHC), and the Pacific Northwest Laboratories (PNL) at Richland, Washington.

The products and services are in some instances unique, in that their production and processing can only be performed in facilities owned by and operated for DOE. DOE is the sole supplier in the Western World of some isotope products and services. These products have found wide applications in research, industry, agriculture, medical diagnosis and therapy.

ISOTOPE PRODUCTION AND DISTRIBUTION

Mr. Bevill. List the quantities and value of the isotopes produced by location.

Mr. Young. The information requested is provided in the chart below which I would like to insert in the record.

PRODUCT CLASSIFICATION

Isotope Class	Subclass	Production Processes	Production Location	1989 Value ($000's)
Radionuclides	Reactor Generated	Neutron-Induced Transmutation	HFIR - ORNL ATR - INEL FFTF - Richland HFBR - BNL	
		Sequential Neutron Transmutations Heavy Isotopes	HFIR ATR FFTF	$6,459
		Fission Products Chemically Recovered from Spent Fuel	ORNL INEL Richland	
	Accelerator Generated	Proton - Multiparticle reactions - Spallation reactions	AGS Linac/BNL LAMPF/LANL, AGS	$1,131
		Low Energy charged particle reactions	ANL Cyclotron	
Separated Stable Nuclides	Electromagnetic Separations	Large-scale Mass Spectrometry	ORNL Calutrons	$5,615
	Separation by Fluid Processing	Thermal Diffusion, Distillation, Centrifugation	Mound Laboratories K-25 Centrifuges, ORNL	$2,303
				$15.508M*

* Total 1989 revenues for the sale of approximately 300 different isotopes and related serv
Includes services as well as sale of isotopes.

ISOTOPE PRODUCTION AND DISTRIBUTION

Mr. Bevill. Describe the policy used to ensure that revenues are equal to the costs of production.

Mr. Young. Prices are based on current cost of production factors for General and Administrative costs, depreciation, and Departmental overhead added to the estimated cost of current production. A small percentage is also added for contingencies to cover items such as standard inventory losses, bad debts, and changing market conditions.

ISOTOPE PRODUCTION AND DISTRIBUTION

Mr. Bevill. Describe the condition of the facilities used in the production of isotopes and what action is required to ensure reliable production.

Mr. Young. Some of the facilities are aged and in need of refurbishment, while others have been well maintained and are suitable for continued productive use. The Office of Isotope Production and Distribution has reviewed the facilities where existing DOE isotope products and services are originating, with the conclusion that where there are facility deficiencies, alternate DOE facilities are available to maintain continuity of essential materials and services. These alternatives avoid the cost of rebuilding or renovating marginal facilities, and in some instances, also avoid the cost of extensive shipping of radioactive materials. In summary, we believe DOE facilities are adequate for continuing the production and processing of isotopes and related services currently supplied by DOE. There are likely to be new isotope products and services which will require new facilities or modifications to existing facilities, and when such needs are identified, a request will be included in the Department's annual budget request to Congress, and will describe the need, and include the economic justification for including the new facilities in the Isotope Distribution and Production Program.

ISOTOPE PRODUCTION AND DISTRIBUTION

Mr. Bevill. Describe the use of the DOE isotopes produced and sold.

Mr. Young. There are hundreds of uses for isotopes in nuclear medicine, research and development, and industry. In nuclear medicine, radionuclide uses include imaging (diagnoses) and treatment of heart diseases, neurological disorders, and many forms of cancer. Isotopes serve as many different tracers, test samples, and for nuclear instrument calibrations. Major specialized uses include that of Krypton-85 for semiconductor production, thickness guaging in paper manufacturing, and jet engine maintenance; use of tritium for remote/emergency lighting; and of Cesium-137 for food irradiation and radiation sterilization.

Mr. Bevill. Why is it not possible for private industry to produce the isotopes required?

Mr. Young. Industry does produce and sell many isotopes. However, DOE has a role because production of some isotopes is not profitable in terms of the private sector requirements, industry lacks specialized facilities such as electromagnetic separators. In addition, hot cells, reactors, accelerators, and some feed materials are from the production of nuclear weapons and are not available to the private sector.

ISOTOPE PRODUCTION AND DISTRIBUTION

Mr. Bevill. Describe the funds required for each of the following categories of isotopes: (1) radioisotopes; (2) Electromagnetically Enriched Stable Isotopes; and (3) Non-EM Enriched Stable Isotopes.

Mr. Young. The total allotted for radioisotopes production is approximately $4.9 million for FY 1990, which includes costs of production, storage, and environment, safety and health. In addition to direct production costs, funds are also provided for program administration, storage, distribution, process development, and marketing. About $4.1 million are required in FY 1990 for electromagnetic (EM) separations sufficient to maintain current inventory levels, and for costs of preparation, sale and distribution of EM products. Funds required for non-EM separated stable isotopes of approximately $0.5 million in FY 1990 are limited to custody of current stocks and costs associated with preparation for sale and distribution.

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Mr. Bevill. America is being faced with rotating blackouts. An article in Monday's Journal points out that those of us who live in Northern Virginia may suffer this summer.

What do you see as the way we are going to meet this shortfall & how quickly will we have it in place?

Mr. Young. The future need for additional electric power will be met through construction of new gas-fired plants, plants using clean coal technology, advanced nuclear powerplants, and solar and renewable energy plants, as well as by reducing future power demand through more extensive deployment of energy conservation technologies and the use of demand management techniques. This capacity should be developed so as to be available when needed and so as to contribute to an economically efficient mix of generating equipment. Institutional obstacles to the achievement of these objectives will be addressed as part of the National Energy Strategy which is now being formulated by DOE.

PROGRAM SCHEDULE

Mr. Bevill. Describe the changes in the program schedule delaying the exploration shaft from 1989 to 1992.

Mr. Rousso. The current program schedule is to start construction of the exploratory shaft facility (ESF) in November 1992 and initiate the surface-based testing program in January 1991, concentrating on the evaluation of site suitability against regulatory requirements, with priority being given to the investigation of potential adverse conditions.

New key ESF milestones are the following:

- o Start Site Preparation: June 30, 1992
- o Start ESF Construction: November 30, 1992
- o Complete Connection of Shafts: September 30, 1995
- o Complete Geologic Drifting: March 31, 1998

The recent repository schedule is based on receiving site access permits in January 1991 which was assumed to have been 1989 in the previous plan. DOE has initiated a study to evaluate alternative plans to construct the ESF. These studies will be completed in late 1990, and following revisions to the ESF design requirements which may result from those studies, the design work will be resumed in March 1991.

Site preparation construction has been rescheduled to start in June 1992 after the design work has been substantially completed. This schedule allows additional time for all construction permits and agreements to be finalized and for special pieces of equipment to be purchased. In November 1992, the site work will have progressed to the point where the construction can proceed.

LITIGATION

Mr. Bevill. Describe the status of the litigation against the State of Nevada to obtain licensing permits.

Mr. Rousso. On January 5, 1990, the State of Nevada filed a suit in the U.S. Circuit Court of Appeals to the Ninth Circuit against DOE, claiming that the State had "disapproved" the Yucca Mountain site. Furthermore, the State returned all of the permit applications that DOE had submitted, claiming that the applications were moot. On January 25, 1990, DOE filed suit against the State of Nevada in the U.S. District Court of Nevada asking that the court rule that the Yucca Mountain site has not been disapproved, that Nevada should act on DOE's permit applications, and that Nevada be prohibited from interfering with DOE's site characterization activities. Nevada filed a Motion for Stay of proceedings on February 15, 1990. On March 2, 1990, DOE filed its opposition and Nevada responded on March 12, 1990. The Court ruling on Nevada's Motion for Stay is being awaited.

SITE CHARACTERIZATION

Mr. Bevill. Describe the technical uncertainties with the Yucca Mountain site that are hoped to be resolved during site characterization.

Mr. Rousso. The major technical uncertainties at Yucca Mountain are related to the natural conditions at the site and the ability to predict how these conditions will affect the performance of the repository in safely containing and isolating high-level waste 10,000 years into the future. The principal uncertainties at the site encompass the areas of ground-water flow, faulting and volcanism, climatic changes, and natural resources. The technical uncertainties associated with Yucca Mountain will be addressed by the results of 106 studies, comprised of over 320 investigations, that are part of the planned site characterization program. These uncertainties cannot be resolved until DOE has access to the site to gather and analyze additional scientific data.

Site characterization will investigate the hydrologic system at the site to reduce the uncertainty regarding the flow mechanism in the unsaturated zone. If ground-water flows through the rock matrix, the travel time from the proposed repository to the accessible environment could be much longer than if the ground-water flows through fractures in the tuff. The sorptive properties of the tuff, which are expected to significantly retard radionuclide migration relative to ground-water travel time, must also be evaluated during site characterization.

Uncertainties regarding tectonic conditions at Yucca Mountain that will be investigated during site characterization focus on what earthquake magnitudes and recurrence intervals are associated with local Quaternary faults, the likelihood and characteristics of potential surface faulting,

and the extent that future tectonic events could effect ground-water conditions. Additionally, the effects of volcanic activity and the probability that the repository could be penetrated by basaltic magma will also be addressed.

Information from climatic studies will be used to determine what impact, if any, future climate changes may have on the ground-water hydrology and, therefore, on the ability of a repository to safely store waste.

Site characterization will assess the potential, now considered unlikely, for mineral and energy resources of economic value, and the expected future supply and demand for ground-water resources near the site. Site characterization will also evaluate the uncertainty associated with the potential for inadvertent human intrusion into the repository as a result of exploration for natural resources.

YUCCA MOUNTAIN SITE

Mr. Bevill. The 1987 amendment to the Nuclear Waste Policy Act designated Yucca Mountain, Nevada, as the site for the first repository. Does any of your analysis to date indicate that this site will not be satisfactory?

Mr. Rousso. The Nuclear Waste Policy Amendments Act of 1987 did not designate Yucca Mountain, Nevada, as the site for the first repository, but rather designated the site for scientific investigation to determine its suitability or non-suitability for a repository. Our analysis to date does not indicate that this site is unsatisfactory; however, due to Nevada's refusal to issue the necessary permits, DOE has been unable to conduct the site characterization work needed to make a definitive determination.

EXTERNAL BOARDS AND COMMISSIONS

Mr. Bevill. Please discuss the role of the MRS Commission. Also, indicate the organization and staffing of the MRS Commission.

Mr. Rousso. The Monitored Retrievable Storage Review Commission was established by the Nuclear Waste Policy Amendments Act of 1987; its 3 members (Alex Radin, Frank Parker, and David Klein) were appointed by the President pro tempore of the Senate and the Speaker of the House of Representatives. The role of the MRS Review Commission was to prepare a report on the need for a monitored retrievable storage facility as a part of a national nuclear waste management system. The Commission submitted its report to the Congress on November 1, 1989, and ceased to exist 60 days after submitting the report.

Mr. Bevill. Please describe the status of the Nuclear Waste Technical Review Board.

Mr. Rousso. The Nuclear Waste Technical Review Board (NWTRB) was established by the Nuclear Waste Policy Amendments Act of 1987. On January 18, 1989, the President announced his selection of eight members to serve on the Board. After an initial meeting in March 1989, the NWTRB established panels in the following five areas: Environmental and Public Health, Structural Geology and Geoengineering, Hydrogeology and Geochemistry, Containers and Transportation, and Risk and Performance Analysis. The NWTRB and DOE have had extensive interactions over the past year, with 15 meetings being held as of March 1, 1990. The Board's first report was issued on March 22, 1990.

Mr. Bevill. What is the status of the selection and appointment of the MRS Commission?

Mr. Rousso. The Monitored Retrievable Storage (MRS) Review Commissioners were sworn into office on June 14, 1988. The MRS Review Commission submitted its report to the Congress on November 1, 1989, and ceased to exist 60 days later consistent with the Nuclear Waste Policy Amendments Act of 1987.

NUCLEAR WASTE NEGOTIATOR

Mr. Bevill. Please describe the status of the Office of the Nuclear Waste Negotiator.

Mr. Rousso. The Nuclear Waste Policy Amendments Act of 1987 provides for a Nuclear Waste Negotiator to be appointed by the President and confirmed by the Senate. The Negotiator is to seek a State or Indian Tribe willing to host a repository or a Monitored Retrievable Storage facility at a technically qualified site on reasonable terms. The Negotiator would seek to reach a proposed agreement specifying the terms and conditions under which the State or Indian Tribe would host such a facility. Any proposed agreement would have to be approved and enacted into law by the Congress. Several candidates for the position of Negotiator have been considered; we understand that a candidate is under final consideration by the White House before formal nomination. The Department has been working with the White House on the appointment of the Nuclear Waste Negotiator.

MONITORED RETRIEVABLE STORAGE

Mr. Bevill. What is the status of the Department's review of a Monitored Retrievable Storage site?

Mr. Rousso. While the Nuclear Waste Policy Amendments Act authorized the Department to conduct a survey and evaluation of potentially acceptable sites subsequent to submittal of the Monitored Retrievable Storage Review Commission's report to the Congress, the Department is pursuing the second path authorized by that Act, that of a volunteer host. The Department has been working closely with the White House in connection with the nomination of Nuclear Waste Negotiator. Nomination of the Negotiator is expected in the near future, and, once confirmed by the Senate, the Department will be prepared to support the Negotiator's efforts to find a volunteer host. The Department is also studying other alternatives that will support efforts to find a volunteer host.

Mr. Bevill. What is the potential of one or more states volunteering to have an MRS positioned in their state?

Mr. Rousso. I believe that there is a reasonable expectation that one or more States would volunteer to host an MRS facility, given the fact that a Nuclear Waste Negotiator may soon be nominated by the President and after confirmation by the Senate would then become active in seeking volunteer MRS sites.

PROGRAM SCHEDULE

Mr. Bevill. Discuss the schedule for licensing of the repository and the date at which the facility will be operating and accepting nuclear waste.

Mr. Rousso. If site characterization demonstrates the suitability of the Yucca Mountain site, and if the site is then chosen, in accordance with the provisions of the Nuclear Waste Policy Act, for development as a repository, a license application would be submitted to the Nuclear Regulatory Commission by October 1, 2001. Under the Nuclear Waste Policy Act timetable, the construction authorization for the repository should be issued by October 4, 2004. Once the facility is ready to operate and accept waste, DOE will amend its application for the license to receive waste and operate the repository to incorporate information obtained during construction. Under this scenario, the facility is expected to be licensed, operating and accepting nuclear waste by January 10, 2010.

EXPLORATORY SHAFT

Mr. Bevill. Describe the work that must be done in order to begin the exploratory shaft excavation at Yucca Mountain by November of 1992.

Mr. Rousso. The Exploratory Shaft Facility (ESF) alternatives study is currently in progress, and the report is expected to be completed by December 1990. The study will support selection of a preferred option to be used for ESF construction. A final design package will be required before start of construction. Site preparation will be completed by October 1992. Certain shaft construction support activities for utilities, concrete batch plant, and lay down areas will need to be in place by November 1992. Drilling of a multi-purpose bore hole will be one of the initial construction activities. This hole will be used in conjunction with tests carried out later during construction. The Department is exploring ways to accelerate this schedule by several months.

Mr. Bevill. Describe the potential legal issues that could delay work on the exploratory shaft.

Mr. Rousso. Prior to commencing new site characterization activities, the DOE must obtain permits to satisfy the appropriate Federal and State environmental requirements. The DOE has received a right-of-way Reservation from the Bureau of Land Management sufficient for site characterization and has applied for administrative withdrawal of a portion of the characterization area to protect the area from mining exploration by outside parties. A settlement has been reached with respect to existing mining claims at Yucca Mountain. The DOE has applied to the State of Nevada for an air registration certificate for fugitive dust from land disturbance, an air quality permit for shaft construction, an underground injection permit for the tracers to be used in the water employed for shaft construction and testing, and a ground water appropriation permit.

The initiation of ground disturbing field work supporting the shaft and surface-based testing cannot begin until the DOE receives the appropriate permits from the State of Nevada. In December 1989, the State of Nevada returned the permit applications that have been submitted by the Department. On January 5, the State filed suit against DOE to terminate site characterization activities at the Yucca Mountain site. On January 25, 1990, the Department of Justice, at DOE's request, filed suit against Nevada to require action on the permit applications. The current schedule is based on the assumption that these suits will be settled before the end of 1990. However, preparation for field work on the exploratory shaft and surface-based activities will continue regardless of the suit status, and settlement of the suits during 1991 would not necessarily delay the exploratory shaft.

SITE CHARACTERIZATION

Mr. Bevill. Discuss the status of the Yucca Mountain site characterization plan. Also, indicate the legal significance of this plan.

Mr. Rousso. Issuance of the statutory Site Characterization Plan (SCP) and its review by the Nuclear Regulatory Commission and the State of Nevada is required by section 113 (b) of the Nuclear Waste Policy Act, as Amended and by 10 CFR 60.16 before the Department can proceed to sink exploratory shafts at Yucca Mountain.

The Yucca Mountain SCP Consultative Draft was issued in January 1988. This document was revised based on comments received and the statutory SCP was issued in December 1988 for formal review by the Nuclear Regulatory Commission, the State of Nevada, any interested parties, and the public. The Department is currently responding to the many comments received on the SCP.

The site characterization program, as presented in the SCP, is flexible and can be modified as new informational needs are identified. Any changes to the site characterization program will be presented in semi-annual progress reports.

COMPUTER ACQUISITION

Mr. Bevill. Please discuss your plans for the acquisition for computers and related computer facilities for the University of Nevada at Las Vegas.

Mr. Rousso. A direct payment for the acquisition of a supercomputer by the University of Nevada at Las Vegas (UNLV) was mandated by Congress in FY 1990. The appropriation from the Nuclear Waste Fund for the purchase of the hardware totalled $10 million. The FY 1989 Appropriation Act appropriated an additional $6 million for Licensing Support System activities at UNLV. Under this appropriation, a cooperative agreement with the College of Engineering currently being developed is to provide technical support to the Licensing Application System program. We have no near term plans for acquiring any other computers or computer facilities for UNLV.

FINANCIAL ASSISTANCE BUDGET

Mr. Bevill. Please describe the process used in developing the budget for the proposed grants to the State and local governments.

Mr. Rousso. In developing the FY 1991 budget for financial assistance to the State of Nevada and the affected units of local government, the Department reviewed the budget requirements information they provided, the level of funding Congress provided for financial assistance in FY 1990, and the status of the repository program. The recommended budget level for FY 1991 of $5 million for the State of Nevada and $5 million for the affected units of local government is based on the Department's estimate of required oversight activities, assuming that site characterization activities proceed on the program's current schedule, and prior year carryover availability.

GRANTS AND FINANCIAL ASSISTANCE

Mr. Bevill. Please indicate the total funding in FY 1989, FY 1990 and FY 1991 for grants and other payments to states and local governments.

Mr. Rousso. In FY 1989, the Department awarded $16,123,234 to the State of Nevada and affected units of local government. Thus far in FY 1990, the Department has awarded $5,000,000 to the State of Nevada and $591,000 to Nye County, Nevada; an additional $4,409,000 remains to be awarded to the affected units of local government in Nevada; the Department is reviewing a cooperative agreement with the University of Nevada/Las Vegas and an award is expected to be made shortly. For FY 1991, the Department is requesting $5 million for the State of Nevada and $5 million for the affected units of local government.

Mr. Bevill. Please provide the funding and description of the various grants and financial assistance authorities available to the Department.

Mr. Rousso. Financial assistance from the Nuclear Waste Fund may be made available to the State of Nevada and affected units of local government pursuant to section 116(c)(1) of the Nuclear Waste Policy Act of 1982 (the Act), for the purpose of oversight of the Department's activities at the Yucca Mountain site. For FY 1991, the Department is requesting $5 million for the State of Nevada and $5 million for the affected units of local government for this purpose. Section 116(c)(2) provides for impact assistance to the State of Nevada and the affected units of local government to mitigate the impact resulting from the development of the repository and characterization of the site; funding is predicated upon the State submitting a report to the Secretary outlining the impacts. The State has not submitted a report, and DOE has not requested funds for FY 1991. Section 116(c)(3) provides for payments-equal-to-taxes to the State of Nevada and affected units of local government; for FY 1991, the Department is requesting $1.6 million. Similar provisions apply to Indian Tribes pursuant to Section 118 of the Act; however, there currently are no affected Indian Tribes, and no funding has been requested under section 118.

Section 170 of the Act provides that the Secretary may enter into a Benefits Agreement with the State of Nevada concerning the repository or with a State or an Indian Tribe concerning a monitored retrievable storage (MRS) facility. Acceptance of the Benefits Agreement requires waiver of impact assistance identified under section 116(c)(2) of the Act; no funds

have been requested for a Benefits Agreement for either the repository or MRS in FY 1991.

Section 149 of the Act provides for financial assistance to States, Indian Tribes, and units of local government regarding an MRS facility, similar to the provisions pursuant to sections 116 and 118. Section 406(b) of the Act provides that the Secretary may make grants to States, Indian Tribes, or units of local government to assess the feasibility of siting an MRS facility in their jurisdiction. For FY 1991, $1.9 million has been requested for financial assistance pursuant to sections 149 and 406(b).

Section 180 provides for financial assistance to States for training for public safety officials of appropriate units of local government and Indian Tribes through which spent nuclear fuel or high level radioactive waste is to be transported. No funds for FY 1991 are being requested under this section.

The Secretary may also direct research projects to a State hosting a repository.

NUCLEAR REGULATORY COMMISSION

Mr. Bevill. Please describe your coordination of work with the Nuclear Regulatory Commission.

Mr. Rousso. The Department and the Nuclear Regulatory Commission are closely coordinating their respective activities through meetings and correspondence to come to a mutual understanding of technical, regulatory, licensing, quality assurance and safety-related issues, with the involvement of the State of Nevada and other affected parties. The Department reviews and comments on NRC rulemakings and other publications, and responds to NRC comments and analyses of Department program documents and proposals.

Mr. Bevill. What specific work is required of the Nuclear Regulatory Commission in support of the civilian nuclear waste program?

Mr. Rousso. The Nuclear Regulatory Commission is involved in the Civilian Radioactive Waste Management Program in a variety of ways, e.g., through the promulgation and update of pertinent regulations, guidelines and Commission staff analyses. Additionally, the NRC reviews the Office of Civilian Radioactive Waste Management Quality Assurance Program Plans and participates in audits of all OCRWM program participants, including DOE, for the purposes of evaluating QA effectiveness prior to the NRC determination of acceptability to initiate quality affecting work. The NRC staff regularly meets with Department staff to resolve regulatory, technical, licensing, and quality assurance issues or concerns. In addition, the NRC performs oversight functions through audits and reviews of the Civilian Radioactive Waste Management Program on both specific topical areas and a program-wide basis.

Mr. Bevill. Does the NRC have sufficient resources devoted to the project in order to assure its completion on schedule?

Mr. Rousso. The Nuclear Regulatory Commission determines what resources are needed for each fiscal year and submits the Commission budget request directly to Congress. Although the funding for Commission activities related to the Civilian Radioactive Waste Management Program are drawn from the Nuclear Waste Fund, the Department is not involved in the determination of resources needed by the Commission, nor in the Commission budget request.

NUCLEAR WASTE FUND

Mr Bevill. Provide a table showing the revenues of the civilian nuclear waste fund by year.

Mr. Rousso. The amount of revenues received by the Nuclear Waste Fund by fiscal year are listed in a table to be provided. (The information follows.)

NUCLEAR WASTE FUND REVENUES
(dollars in thousands)

Fiscal Year	One-time Fees	Quarterly Fees	Investment Income
1983	$ 0	$ 73,600	$ 0
1984	0	329,500	0
1985	1,426,200	367,500	32,745
1986	5,500	362,300	148,910
1987	6,000	434,800	147,771
1988	5,900	498,100	145,280
1989	6,028	513,055	169,086
Subtotal	1,449,628	2,578,855	643,792
TOTAL			4,672,275

Mr. Bevill. What are the cumulative expenditures and cumulative receipts of the civilian nuclear waste program through FY 1991?

Mr. Rousso. The cumulative expenditures and cumulative receipts for the Civilian Radioactive Waste Management Program through FY 1991 are listed in a table to be provided.

(The information follows.)

CIVILIAN RADIOACTIVE WASTE PROGRAM

CUMULATIVE EXPENDITURES AND RECEIPTS

(dollars in thousands)

Fiscal Year	One-time Fee	Quarterly Fee	Investment Income	Cumulative Receipts	Annual Expenses	Cumulative Expenses
1983	$ 0	$ 73,600	$ 0	$ 73,600	$ 168,900	$ 168,900
1984	0	329,500	0	403,100	271,500	440,400
1985	1,426,200	367,500	32,745	2,229,545	315,700	756,100
1986	5,500	362,300	148,910	2,746,255	385,100	1,141,200
1987	6,000	434,800	147,771	3,334,826	446,100	1,587,300
1988	5,900	498,100	145,280	3,984,106	405,100	1,992,400
1989	6,028	513,055	169,086	4,672,275	347,884	2,340,284
1990	6,000	537,000	193,900	5,409,175	339,000	2,679,284
1991	6,000	320,000	220,000	5,955,175	325,000	3,004,284

Note: FY 1990 and 1991 receipts and expenses are estimated.

Mr. Bevill. What is the annual and total estimated revenues in each fiscal year through completion and what charges are assumed in each of these years?

Mr. Rousso. The estimates of revenues and charges over a program expected to last until the year 2075 are obviously subject to great uncertainties. Among the important variables are the annual inflation and real interest rates available on positive fund balances plus the decision to be made about 10 years hence concerning one versus two repositories. For illustrative purposes, the attached chart shows the status of the Nuclear Waste Fund each year for 85 years assuming (1) no new orders of nuclear plants, (2) no increase in the current fee, (3) a single repository and MRS, and (4) inflation and real interest rates of 2.6 percent and 2.0 percent.

Civilian Portion of Projected Cash Flows and Year End Fund Balance -
EIA No New Orders, Single Repository with Basic MRS,
2.0% Real Interest with 2.60% Inflation

(Millions of Dollars)

YEARS	REVENUES FROM FEES[a]	INTEREST EARNED	TOTAL REVENUES	1990 TSLCC EXPENSES (1988 $)	TSLCC EXPENSES ESCALATED BY INFLATION (Current $)	FUND BALANCE
1989						$2,847[b]
1990	$537	$132	$669	$317	$339	$3,177
1991	$320	$148	$468	$297	$325	$3,320
1992	$540	$154	$694	$484	$544	$3,470
1993	$545	$161	$706	$540	$623	$3,553
1994	$549	$165	$714	$487	$576	$3,691
1995	$555	$172	$727	$415	$504	$3,914
1996	$555	$182	$737	$374	$466	$4,185
1997	$560	$195	$755	$406	$519	$4,421
1998	$567	$206	$773	$642	$842	$4,352
1999	$568	$202	$770	$609	$819	$4,303
2000	$2,439	$200	$2,639	$411	$567	$6,375
2001	$544	$297	$841	$338	$479	$6,737
2002	$544	$313	$857	$302	$439	$7,155
2003	$548	$333	$881	$295	$440	$7,596
2004	$551	$353	$904	$289	$442	$8,058
2005	$551	$375	$926	$361	$567	$8,417
2006	$551	$392	$943	$411	$662	$8,698
2007	$553	$405	$958	$452	$747	$8,909
2008	$555	$414	$969	$437	$741	$9,137
2009	$549	$425	$974	$402	$699	$9,412
2010	$535	$438	$973	$349	$623	$9,762
2011	$519	$454	$973	$299	$547	$10,188
2012	$498	$474	$972	$308	$579	$10,581
2013	$463	$492	$955	$276	$532	$11,004
2014	$407	$512	$919	$258	$510	$11,413
2015	$369	$531	$900	$348	$706	$11,607
2016	$343	$540	$883	$303	$631	$11,859
2017	$316	$552	$868	$314	$671	$12,056
2018	$306	$561	$867	$303	$664	$12,259
2019	$304	$570	$874	$353	$794	$12,339
2020	$294	$574	$868	$316	$729	$12,478
2021	$279	$580	$859	$319	$755	$12,582
2022	$257	$585	$842	$307	$746	$12,678
2023	$230	$590	$820	$313	$780	$12,718
2024	$201	$592	$793	$303	$775	$12,736
2025	$164	$592	$756	$307	$805	$12,687
2026	$128	$590	$718	$314	$845	$12,560
2027	$86	$584	$670	$318	$878	$12,352
2028	$55	$575	$630	$299	$847	$12,135
2029	$41	$565	$606	$301	$875	$11,866
2030	$33	$552	$585	$313	$933	$11,518
2031	$20	$536	$556	$320	$979	$11,095
2032	$7	$516	$523	$301	$945	$10,673
2033	$7	$497	$504	$334	$1,076	$10,101
2034	$7	$470	$477	$316	$1,044	$9,534
2035	$7	$444	$451	$357	$1,210	$8,775
2036	$7	$408	$415	$305	$1,061	$8,129
2037	$6	$378	$384	$272	$971	$7,542
2038		$351	$351	$298	$1,091	$6,802
2039		$316	$316	$285	$1,071	$6,047
2040		$281	$281	$268	$1,033	$5,295

Civilian Portion of Projected Cash Flows and Year End Fund Balance -
EIA No New Orders, Single Repository with Basic MRS,
2.0% Real Interest with 2.60% Inflation

(Millions of Dollars)

YEARS	REVENUES FROM FEES[a]	INTEREST EARNED	TOTAL REVENUES	1990 TSLCC EXPENSES (1988 $)	TSLCC EXPENSES ESCALATED BY INFLATION (Current $)	FUND BALANCE
2041		$246	$246	$269	$1,064	$4,477
2042		$208	$208	$234	$949	$3,736
2043		$174	$174	$39	$162	$3,748
2044		$174	$174	$47	$201	$3,721
2045		$173	$173	$40	$175	$3,719
2046		$173	$173	$34	$153	$3,739
2047		$174	$174	$33	$152	$3,761
2048		$175	$175	$33	$156	$3,780
2049		$176	$176	$33	$160	$3,796
2050		$177	$177	$33	$164	$3,809
2051		$177	$177	$33	$169	$3,817
2052		$178	$178	$33	$173	$3,822
2053		$178	$178	$33	$178	$3,822
2054		$178	$178	$33	$182	$3,818
2055		$178	$178	$33	$187	$3,809
2056		$177	$177	$33	$192	$3,794
2057		$176	$176	$33	$197	$3,773
2058		$176	$176	$33	$202	$3,747
2059		$174	$174	$33	$207	$3,714
2060		$173	$173	$48	$309	$3,578
2061		$166	$166	$48	$317	$3,427
2062		$159	$159	$48	$325	$3,261
2063		$152	$152	$48	$334	$3,079
2064		$143	$143	$48	$343	$2,879
2065		$134	$134	$48	$351	$2,662
2066		$124	$124	$48	$361	$2,425
2067		$113	$113	$48	$370	$2,168
2068		$101	$101	$48	$380	$1,889
2069		$88	$88	$48	$389	$1,588
2070		$74	$74	$48	$400	$1,262
2071		$59	$59	$33	$282	$1,039
2072		$48	$48	$33	$289	$798
2073		$37	$37	$33	$297	$538
2074		$25	$25	$33	$304	$259
2075		$12	$12	$33	$312	($41)
TOTALS			$44,544		$47[illegible]2	($41)[c]

[a] Revenues from fees include ongoing fee collected at 1 mill/kWh and one-time fee plus accrued interest for wastes existing before April 7, 1983.

[b] Fund balance at the end of FY 1989 includes the following:
- U.S. treasury securities and cash on-hand in the amount of $2,250 million
- receivables from utilities, accrued interest on U.S. Treasury securities, estimated defense share of costs paid out from the Nuclear Waste Fund, and other receivables and advances for a total of $665 million
- liabilities from accounts payable and accrued expenses of $68 million.

[c] This is -$4 expressed in 1988 dollars.

LITIGATION

Mr. Bevill. Please provide a list and status of all outstanding litigation. What impact has the passage of the NWPA Amendments of 1987 had on the outstanding litigation?

Mr. Rousso. Enactment of the Nuclear Waste Policy Amendments Act of 1987 (NWPAA) affected pre-existing litigation concerning siting guidelines promulgated by DOE (Environmental Policy Institute et al. v. Watkins), and environmental assessments used in nominating and recommending sites for a proposed repository. The court granted the DOE motion to dismiss as moot actions involving various sites no longer under consideration for characterization in light of the NWPAA designation of Yucca Mountain, Nevada, as the sole candidate site. Similarly, in Nevada v. Watkins (environmental assessments), claims regarding Washington and Texas candidate sites became moot. Cases involving Yucca Mountain have been consolidated. A list of outstanding litigation is attached.

1. **United States v. State of Nevada**, case no. CV-S-90-065-HDM,RJJ, **United States District Court, District of Nevada** ("Permits" case)

   Key chronology - complaint filed 1/25/90; Nevada motion for stay filed 2/20/90; Nevada answer filed on or about 3/12/90.

   DOE filed complaint on 1/25/90 for declaration that Nevada has not submitted effective notice of disapproval pursuant to section 116(b)(2) of NWPA, and order that State act upon DOE permit applications. State filed motion for stay of proceedings on 2/20/90. Motion alleges that U.S. Court of Appeals for the Ninth Circuit has original and exclusive jurisdiction under Section 119(a) of NWPA, and that U.S. v. Nevada raises issues identical to those in Nevada suit, #3 below. On 3/2/90 DOE filed its opposition. Last activity: State filed answer and reply memorandum in support of motion for stay on or about 3/12/90.

2. **SEMCO v. U.S.**, case no. 90-52C, **U.S. Claims Court (Second "Management Contract" case)**

   Key chronology - complaint filed 1/17/90.

   Systems Engineering and Management Company (SEMCO), disappointed bidder for Systems Engineering, Development and Management (SEDM) contract, filed suit to enjoin award of any part of work under SEDM contract to Bechtel, and to enjoin DOE from excluding SEMCO from settlement negotiations with TRW and Bechtel, and for 1.5 million dollars in bid preparation costs. SEMCO filed motion for permanent injunction on 1/25/90. On 2/2/90, DOE filed motion to dismiss portion of complaint requesting equitable relief. Intervenors Bechtel and TRW have filed similar motions. On 2/27/90 SEMCO filed its opposition. Last activity: DOE reply to SEMCO opposition filed on 3/5/90.

3. **Nevada v. U.S. DOE**, case no. 90-70004, **U.S. Court of Appeals for the Ninth Circuit ("Notice of Disapproval" case)**

   Key chronology - petition filed 1/5/90.

   State of Nevada filed petition on 1/5/90 for declaration that actions of Nevada State Legislature constitute notice of disapproval under Section 116 of NWPA, and that Yucca Mountain is unsuitable for development as repository. State seeks order that DOE terminate site characterization activities at Yucca Mountain. Index for DOE administrative

record filed on 2/12/90. Certified administrative record and Nevada opening brief due 4/26/90; DOE answering brief due 5/28/90. Nevada reply brief due within 14 days of service of answering brief. Last activity: order setting briefing schedule filed on 2/20/90.

4. **TRW Environmental Safety Systems, Inc. v. U.S.**, case nos. 90-5013, 90-5014 and 90-5020, **U.S. Court of Appeals for the Federal Circuit ("Management Contract" case)**

Key chronology - appeals filed on or about 10/23/89; consolidated 11/8/89.

On 3/22/89, U.S. Claims Court granted motion by TRW, disappointed bidder, enjoining DOE from awarding SEDM contract to anyone other than TRW. On or about 10/23/89 DOE, TRW, and Bechtel, the bidder to whom DOE initially proposed to award the contract, filed separate appeals which were consolidated on 11/8/89. Parties have stipulated to defer briefing of issues on appeal until 4/3/90 in order to attempt settlement negotiation. On 2/27/90, Court denied motion to intervene by SEMCO, yet another disappointed bidder. Last activity: SEMCO motion for reconsideration filed on 3/5/90.

5. **County of Esmeralda, Nevada and County of Inyo, California v. DOE**, case nos. 89-70142 and 89-70162, **U.S. Court of Appeals for the Ninth Circuit ("Affected Unit of Local Government" cases)**

Key chronology: petitions filed 3/24/89 and 4/7/89; consolidated 5/31/89.

Consolidated cases seeking review of Secretary's decision to deny counties' request for designation as affected units of local government pursuant to Section 2(31) of NWPA. Briefing completed on 2/13/90. Oral argument yet to be scheduled. Last activity: Reply brief of Esmeralda County filed on 2/13/90.

6. **Nevada v. Burford**, case no. 89-15272, and **Nevada v. Watkins**, case no. 86-7308, **U.S. Court of Appeals for the Ninth Circuit ("Land Use" cases)**

Key chronology - petitions filed 3/1/89 and 5/28/86.

Related but unconsolidated land use cases seeking review of decision to perform site characterization of Yucca Mountain without withdrawing public land pursuant to Federal Land Policy and Management Act. On 2/20/90 Court consolidated Nevada v. Watkins, case no. 86-7308 with Nevada v. U.S. DOE,

case no. 90-70004. Court also ordered that case no. 89-15272, while not consolidated, will follow same briefing schedule as case no. 86-7308 and case no. 90-70004, as set forth in #3 above. Last activity: order filed on 2/20/90 setting briefing schedule.

7. **Nevada v. Watkins**, case no. 86-7309 and consolidated cases, **U.S. Court of Appeals for the Ninth Circuit ("Environmental Assessment" cases)**

Key chronology - petition filed 5/28/86; consolidated 10/29/86.

Consolidated cases originally challenged adequacy of environmental assessments and procedures used in nomination and recommendation of three sites for proposed repository. With passage of NWPAA designating Yucca Mountain as sole site for characterization, claims regarding adequacy of other two candidate sites became moot. Cases involving Yucca Mountain have been consolidated. DOE motion to dismiss Nevada v. Watkins (for mootness) pending. DOE has allowed examination of documents. Court has yet to set forth schedule for hearing case. Last activity: DOE motion to dismiss.

8. **Environmental Policy Institute et al. v. Watkins**, case no. 84-7854 and consolidated cases, **U.S. Court of Appeals for the Ninth Circuit ("Siting Guidelines" cases)**

Key chronology - petition filed: 12/18/84.

Consolidated cases challenging promulgation and application of siting guidelines issued by DOE pursuant to NWPA. Court granted DOE motion to dismiss cases involving candidate sites other than Yucca Mountain. The only remaining siting guidelines case, Nevada v. Watkins, case no. 85-7308 (filed 5/29/85) will be consolidated with environmental assessment cases, #7 above. Next activity: conference call regarding briefing schedule.

MANAGEMENT AND OPERATING CONTRACTOR

Mr. Bevill. Discuss the plans for obtaining an Integration Contractor.

Mr. Rousso. In an effort to enhance the integration of contractor activities and products, the Office of Civilian Radioactive Waste Management had planned to hire a management-and-operating (M&O) contractor. In 1988, after issuing a request for proposals and receiving three proposals, the DOE selected Bechtel as the M&O contractor, but one of the unsuccessful bidders (TRW) subsequently filed suit and a permanent injunction was issued against awarding the contract to any firm other than plaintiff.

The Department is appealing this decision. However, the parties to that litigation (Bechtel and TRW) have agreed to a delay in the briefing schedule in order to determine whether a settlement of this case is possible. We are presently talking to those parties.

Mr. Bevill. America is being faced with rotating blackouts. An article in Monday's Journal points out that those of us who live in Northern Virginia may suffer this summer.

What will be our energy needs by 2000?

Mr. Young. It is forecast that electric energy demand in the United States will grow at a rate of about 2.7 percent per year over the decade of the 1990s. This rate of growth would result in a need for an additional 109,000 MWe of generating capacity as projected in the base case of the latest Energy Information Administration's Annual Energy Outlook report.

Mr. Bevill. You have recently funded a $50 million program in advanced light water reactor design. I understand that additional funding is necessary to have these plants on line by the year 2000.

What is your program for first of a kind engineering & testing of systems to allow you to achieve that?

Mr. Young. The new Department of Energy contracts covering the Westinghouse AP600 and General Electric Simplified Boiling Water Reactor simplified passive plants will support the completion of a major part of the detailed design, as well as the certification of these plants by the Nuclear Regulatory Commission. However, a substantial amount of additional work will be needed to achieve the final design. This work would include all construction-related engineering, detailed drawings, procurement specifications, and site-specific engineering. All first time engineering needed to provide the manufacturing capability, tooling, techniques, and facilities to produce systems and structural modules and onsite prefabrication facilities for construction of these plants also would be included. It is estimated that this first of a kind and construction-related work may cost up to $200 million per plant.

Mr. Bevill. You have recently funded a $50 million program in advanced light water reactor design. I understand that additional funding is necessary to have these plants on line by the year 2000.

Will you submit a proposed scope & cost to the committee, please?

Mr. Young. This additional first of a kind engineering will be needed to facilitate turnkey (fixed price) offers of these plants.

We have not yet prepared a specific plan for participating in a program to perform this additional work. Further discussion and coordination with the nuclear industry will be necessary to develop the best approach, options, cost share arrangements, and other key factors that must be defined for a cooperative program of this type to be effective. We intend to prepare such a plan to support a FY 1992 budget request.

Mr. Bevill. And, I have been told by utility & industry people that these plants will take 3 years to assemble, and be sold on a fixed price basis. Is that your understanding?

Mr. Young. Regarding plant construction time, we expect that the Westinghouse AP600 and General Electric (GE) Simplified Boiling Water Reactor plants can be constructed in 3 years. This is about 2.5 years shorter than the planned construction time for the first large GE Advanced Boiling Water Reactor plant to be built in Japan. We are confident that this reduced construction time can be achieved. Based on a 3 year construction duration, and Nuclear Regulatory Commission certification of these plants by mid-1995 as planned in the DOE program, the first plants should be operating by the turn of the century. The exact terms under which the plants will be offered by the vendors remain to be established.

Mr. Bevill. How can we speed this effort up to have these plants available as soon as possible?

Mr. Young. We certainly appreciate your support and share your desire to have these plants available as soon as possible. At this time, assuming that our funding requests for the next several years are approved, we believe that the program is on track and is paced about right in terms of the additional design and development work that needs to be done.

ACTIONS TO REDUCE OIL IMPORTS

Mr. Bevill. What are we doing to minimize our trade deficit in regards to importation of oil?

Mr. Young. The Department of Energy is examining a range of policy options within the context of the National Energy Strategy (NES). The options are intended to limit the rise in oil imports, consistent with sound economic and environmental policy, by increasing domestic production and reducing demand for oil. The policy options under review in the NES include: providing Federal and State financial incentives for domestic oil and gas production; adopting Federal policies to increase environmentally sound domestic oil production from Federal lands; taking appropriate steps to retain nuclear power as a viable option for future expansion; continuing to make gains in conservation and energy efficiency; removing statutory and regulatory barriers to increased use of natural gas; pursuing alternative fuels for transportation, if they make economic sense; and supporting research and development of renewable energy resources. In some cases, the Administration is already moving forward with measures that would limit the rise in oil imports and thereby help to reduce our trade deficit. These measures include a proposed program of incentives for domestic oil exploration and production, a recently announced 11-point conservation and renewable energy initiative, and implementation of the Alternative Motor Fuels Act of 1988.

EFFECT OF NUCLEAR POWER ON GREENHOUSE PROBLEMS

Mr. Bevill. How does nuclear power impact on the greenhouse problem?

Mr. Young. The expanded use of nuclear power could play an important role in helping to reduce CO2 emissions.

The U.S. electric utility industry emits approximately 500 million metric tons of carbon per year in the form of carbon dioxide. If there were no nuclear power in the United States today, the industry would produce 25 to 30 percent more carbon dioxide. Looking to the future, 100,000 MWe of new nuclear capacity would prevent the release of 100 million metric tons of carbon per year, or 20 percent of current electric utility CO2 emissions (or about 7 percent of current total U.S. emissions).

INTEGRAL FAST REACTOR

Mr. Myers. Mr. Young, in testimony before the Subcommittee earlier this week, Admiral Watkins described the progress made in the DOE advanced liquid metal reactor (ALMR) program. In particular, he emphasized the importance of demonstrating the ability of advanced technologies to recycle fission products. What role does the Integral Fast Reactor (IFR) technology have in reaching this goal?

Mr. Young. A key feature of the IFR concept is the development of the metal fuel cycle that has shown promise to be able to recycle, and then destroy by fissioning in a liquid metal reactor, the actinides that greatly complicate conventional nuclear waste disposal scenarios. The Department's program is focused on the demonstration of the actinide recycle capability and, under a new initiative in FY 1991, will begin studies to determine the capability of the metal fuel cycle to play a key role in the recycle of actinides from spent light water reactor fuel.

INTEGRAL FAST REACTOR

Mr. Myers. What is the fiscal 1991 budget request, not including facilities operations, for the IFR program at Argonne National Laboratory in Idaho? How does this compare to the fiscal 1990 appropriation for the same program.

Mr. Young. The FY 1991 request for IFR concept work, namely, the metal fuel cycle efforts at Argonne National Laboratory (ANL), is $10 million. In FY 1990, $18.4 million was provided to ANL for metal fuel cycle and other technology work related to the IFR concepts.

Mr. Myers. If the IFR concept holds such promise for the future of nuclear energy, why has the Department reduced the funding for liquid metal programs including the IFR in the budget request for fiscal 1991?

Mr. Young. The FY 1990 recycle facility modifications at Argonne National Laboratory are nearing completion. The FY 1991 funding provides for the facility operations, with some funding to complete the Hot Fuel Examination-South modifications and to initiate the fuel recycle demonstrations. These efforts require less funding. Also, near-term program priorities in nuclear energy focused on activities to help remove institutional impediments to any new reactor must take precedence over long-term research efforts such as for the IFR concept.

POWER REACTOR INHERENTLY SAFE MODULE

Mr. Myers. Describe the fiscal 1991 budget request for the ALMR design (PRISM), including the non-federal participation in fiscal 1991.

Mr. Young. The Nuclear Regulatory Commission (NRC) staff issued a Draft Safety Evaluation Report (SER) of the Power Reactor Inherently Safe Module (PRISM) design in October 1989. FY 1990 and 1991 design activities will focus on continuing the advanced conceptual design of the nuclear island and on resolving the key safety and licensing issues raised in the Draft SER. Under our international exchange agreements, we have access to related liquid metal reactor (LMR) design and technology programs being pursued in Europe and in Japan. In FY 1991, about $15 million of cost-sharing with Japan on LMR technology is expected. Such exchanges benefit DOEs design activities. The cooperative work on PRISM design does not provide direct transfer of funds, however, into the Department of Energy (DOE) design program.

INTEGRAL FAST REACTOR

Mr. Myers. When does the Department expect to proceed with a prototype reactor to demonstrate the IFR technology? Is this the optimum schedule?

Mr. Young. The Department's decision regarding a prototype demonstration of an advanced liquid metal reactor will largely depend upon the satisfactory resolution with the Nuclear Regulatory Commission of key safety and licensing basis issues, and positive initial results expected in late FY 1993 from fuel recycle and actinide efforts. We believe this schedule to be appropriate.

STANDARDIZED REACTOR DESIGNS

Mr. Myers. Update the Subcommittee on the Department's cooperative effort to achieve the NRC certification of standardized reactor designs and the supporting budget request for fiscal 1991.

Mr. Young. The FY 1991 budget request for the Advanced Light Water Program is $31.5 million; of this $0.5 million is being requested for the evolutionary standardized plant and $20.0 million for the mid-sized standardized plant. With respect to the evolutionary plant, we expect Nuclear Regulatory Commission (NRC) certification of the General Electric Advanced Boiling Water Reactor by 1991. Assuming additional funds are provided for Combustion Engineering to complete its work on the System 80+ design, we would expect its NRC certification about 1 year later--in 1992. With respect to the mid-sized plant, we are now moving forward with the next phase of this effort--the detailed design, development, and certification of two reactors--the Westinghouse AP600 and the General Electric Simplified Boiling Water Reactor. Our goal is to certify these two by 1995.

MODULAR HIGH TEMPERATURE GAS-COOLED REACTOR

Mr. Myers. Please explain how your office will coordinate the research and development of a commercial modular high temperature gas-cooled reactor (MHTGR) with the MHTGR effort in the New Production Reactor program.

Mr. Young. Identification of areas of commonality and the coordination of research and development to the maximum extent practicable is being carried out by a group consisting of staff members from both programs. Examples of common areas of work that have been identified include fission product behavior, materials development, reactor shielding, vessel and cross ducts, and large component development. Also, there are several other areas where portions of the work are common. As the design progresses, the list of common elements will continue to be reassessed, assuring an effective utilization of Department funding.

FAST FLUX TEST FACILITY

Mr. Myers. The FY 1991 budget request assumes the shutdown of the FFTF at Hanford. As you know, the related reprogramming proposal has not received congressional approval. What additional funding would be necessary in fiscal 1991 to continue the current level of activities at the FFTF?

Mr. Young. The Fiscal Year 1991 Budget Request for the FFTF at Hanford is $46.6 million which is the amount required to conduct shutdown activities in that year. Should the FFTF continue the current level of activities in Fiscal Year 1991, additional funds in the amount of approximately $55 million would be required.

ACTINIDE BURN IN FAST FLUX TEST FACILITY

Mr. Myers. Please explain the role of the FFTF in demonstrating actinide burn theories.

Mr. Young. The limited quantity of defense wastes that would be available for burning in FFTF, but not before 1997, does not justify the more than $100 million per year required to operate the Fast Flux Test Facility into the late 1990s.

The Department plans to initiate an actinide recycle effort in FY 1991. The significant accomplishments made in the metal fuel cycle technology development efforts at the Argonne National Laboratory show promise that an actinide recycle program, focused on the recycle of spent light water reactor fuel, can capitalize on these accomplishments. We believe that this actinide recycle effort can be executed more effectively and efficiently at the EBR-II complex.

Mr. Myers. What is your view of the impact resulting from the recent NRC decision to approve the operating license for the Seabrook nuclear plant?

Mr. Young. Although the licensing of Seabrook may not have any immediate, large positive effect on the future of the nuclear option, it would have had a negative effect if it had not been licensed. This long-delayed licensing action demonstrates once again that nuclear power is considered to be an important energy option by the electric utility industry, even in cases where tremendous obstacles must be overcome. It also reinforces the fact that rational men can prevail through perseverance.

However, we as a Nation must find a way to make the licensing process more efficient. Nearly two decades to license a nuclear plant costing in excess of $6 billion is unacceptable. Congress needs to consider nuclear licensing reform legislation on a priority basis if there is to be a revitalization of the U.S. nuclear option.

NRC LICENSING REFORM RULE

Mr. Myers. Although the new NRC licensing reform rule is an improvement, it is not one-step licensing. Do you believe that this rule will make the licensing process more efficient if a post-construction review is still available?

Mr. Young. Reform of the system by which nuclear powerplants are licensed is critical if the nuclear power option is to be part of our Nation's energy future. The utility industry and the financial community are reluctant to risk investment in nuclear power unless they can have reasonable assurance that a plant can be operated without undue delay after it is completed. The Nuclear Regulatory Commission's (NRC) recent standardization and licensing reform rule (10 CFR 52) is a major step toward the needed reform, but it retains a few aspects that will discourage the rule's use.

The Department agrees with you that the new rule stops short of one-step licensing, primarily because it does not eliminate the possibility of lengthy procedural delays when construction is complete and a plant is ready for operation. It retains the possibility of a formal adjudicatory hearing on whether one or more acceptance criteria in the combined license have been met or on a petition to modify the terms and the conditions of the combined license. In addition, emergency planning issues are not fully addressed in the rule, particularly those involving tests and exercises. Their resolution is subject to a formal adjudicatory hearing when the plant is ready for operation.

The rule also requires an opportunity for a formal adjudicatory hearing for any requested amendment of the terms of a combined license and requires that any hearing held be completed before operation. The rule should be revised to require Commission consideration of amendments to combined construction and operating licenses to be the same as for amendments to operating licenses, which allow approval of amendments without a hearing if no significant hazards are involved.

The new NRC rule does make the licensing process more efficient. However, the Department believes that resolution of the problems discussed is necessary to allow nuclear power once again to be seen as a viable option and to play a significant role in our future national energy supply. Legislation may be required to allow resolution of these problems with the rule.

SPACE/DEFENSE POWER SYSTEMS

Mr. Myers. Please explain how the amendment to the existing SP-100 Memorandum of Agreement affects the DOE role in this program. What is the impact on the fiscal 1991 budget request?

Mr. Young. The principal purpose of adding this amendment to the existing SP-100 Memorandum of Agreement was to reconfirm user agency support and outyear funding commitments for the SP-100 Program. This amendment did not change DOE's role in the SP-100 program. Also, DOE's fiscal 1991 budget request will not be impacted by this change since the amount we have requested and that listed in the amended Memorandum of Agreement for fiscal 1991 are the same.

U.S. URANIUM ENRICHMENT CORPORATION

Mr. Myers. How will the creation of a Government-owned uranium enrichment corporation improve the competitiveness of the existing operation?

Mr. Young. A Government corporation would be a significant improvement over the current situation because it would be more flexible than a conventional Government agency with respect to budgeting, marketing, contracting, management, and administration. It would be better able to make sound business decisions and more likely to instill customer confidence in the enterprise as a reliable, economical, long-term supplier of enrichment services. It could enhance the value of, and maximize the return on, the taxpayers' investment in the enterprise and assure the lowest possible price of enrichment services to commercial and defense customers.

U.S. URANIUM ENRICHMENT CORPORATION

Mr. Myers. How would the fiscal 1991 budget for DOE be affected if the proposed legislation to establish a Government-owned corporation is not enacted?

Mr. Young. If the proposed legislation is not enacted, the Administration would not request budget authority of $29 million, for the interest payment on the proposed $364 million debt, or $45.5 million for dividends and working capital. The Administration would request that the Committee approve an appropriation of $1,406,018,000 for all ongoing enrichment activities that are not dependent on the proposed legislation. In addition, the Administration would request that the Committee approve appropriation language to allow transfer of $50,000,000 of FY 1991 revenue collections to a Decontamination and Decommissioning Fund in the Treasury.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Myers. Please update the Subcommittee on the status of the AVLIS program. Are there any similar laser separation research and development programs anywhere else in the world? If so, please elaborate.

Mr. Young. The Uranium-Atomic Vapor Laser Isotope Separation, U-AVLIS, program is at an advanced stage of technical development. The laser and separator systems have operated at significant scale; thereby providing a sound basis for projecting enrichment performance at full scale and the ultimate economics of the process. Specifically, the designs for the major components of the various systems have been established, have undergone prototype testing, and procurements are currently being made that will allow for the demonstration of the process at full scale by the end of FY 1992. I am convinced that there are no technical show stoppers that would preclude deploying a U-AVLIS enrichment process; however, the demonstrations are necessary in order to provide confirmation that the cost of production is as currently projected.

There are two major U-AVLIS development efforts ongoing today in the free world. These are in France and Japan. The French program has been ongoing since the early 1970s and is judged to be about 5 years behind the U.S. efforts. They have indicated that it is their intent to operate a pilot facility this decade and then possibly deploy the technology initially for the reenrichment of uranium that results from the reprocessing of their LWR fuels. The Japanese program was maintained at a low level for a number of years with a decision to undertake a major effort only after the United States had chosen the U-AVLIS technology as the "enrichment technology for the 21st Century" in 1985. It is our understanding that they plan to choose between U-AVLIS, centrifuge, and a chemical exchange process for their next increment of enrichment in 1992.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Myers. What are the remaining technical issues associated with AVLIS?

Mr. Young. The Department has concluded that there are no outstanding technical issues that need to be resolved with respect to the enrichment of uranium using Uranium-Atomic Vapor Laser Isotope Separation, U-AVLIS, technology. Both the Department and independent reviewers have established that U-AVLIS enrichment performance projections at near plant scale are founded on a solid demonstrated basis. The most significant uncertainty is associated with the cost or economics of the U-AVLIS enrichment process at plant conditions. The remaining economic performance uncertainties in projection to plant scale will be narrowed by the 1992 full-scale demonstration under plant conditions.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Myers. Please describe any private sector involvement in the development of AVLIS. Are any private entities interested in deploying this technology?

Mr. Young. Currently, private sector involvement is limited to traditional vendor support where parts suppliers have been qualified for laser and optical components, special power supplies and limited separator components. As the first step in supplementing this industrial infrastructure with additional industrial capabilities that will be needed to support the transition to a commercial application of the Uranium-Atomic Vapor Laser Isotope Separation, U-AVLIS, technology, the Department plans to establish an industrial access program in late FY 1990. This program will allow DOE to provide classified information to approved firms and should result in a significant increase in industrial involvement. The second step will involve the issuance of a request for proposal in 1990 by the Department for a commercial deployment contractor. It is planned that selection of a commercial deployment contractor would be made by mid-FY 1991.

NUCLEAR WASTE FUND

Mr. Myers. Is the fiscal 1991 budget request of $292.8 million for the Nuclear Waste Fund realistic in view of the substantial administrative, legislative, and legal hurdles facing the Department on the Yucca Mountain project?

Mr. Rousso. Yes, the fiscal 1991 budget request is realistic. The current hurdles facing Yucca Mountain have prevented initiation of any new surface-disturbing activities but have not stopped the very significant ongoing work involving: seismic, hydrologic and meteorologic monitoring; laboratory sample analysis; development of predictive models; and performance assessment activities. Litigation is underway to resolve the hurdles to beginning surface disturbing work.

The FY 1991 request is based on DOE's restructured program presented in the November 1989 report to the Congress. In addition to the ongoing activities at Yucca Mountain, emphasis in 1991 will be placed on: start of new surface-based site characterization activities in January 1991; completion of alternative design studies and the beginning of Title II design for the exploratory shaft; providing grant funds for oversight activities to affected units of local governments and to the State of Nevada; and on developing and maintaining a Quality Assurance Program accepted by the Nuclear Regulatory Commission.

The Monitored Retrievable Storage program (MRS) will initiate design evaluations of potential technologies, implement the overall MRS strategy, and and be prepared to conduct a grant program for site feasibility studies.

The Transportation program will complete design reviews on legal weight truck and rail/barge casks and continue to conduct engineering, drop and design verification tests and cooperative agreements with national and regional groups.

LITIGATION

Mr. Myers. What is the status of legal actions related to the characterization of the Yucca Mountain site?

Mr. Rousso. The State of Nevada filed a petition for Motion to Stay in the U.S. Court of Appeals for the Ninth Circuit on January 5, 1990, asking for an order directing the Department to terminate site characterization activities at the Yucca Mountain site. Nevada's opening brief is due April 26, 1990; DOE's response brief is due May 28, 1990; and Nevada's reply is due 14 days after receiving DOE's response brief. No date has been set for oral argument, but is expected for early September.

With regard to the suit filed in the U.S. District Court of Nevada (United States v. State of Nevada), the Department of Justice, on behalf of DOE, filed a complaint on January 25, 1990, asking for an order requiring Nevada to act on the permit applications that are required to initiate new ground disturbing activities at the Yucca Mountain site. On March 2, 1990, DOE filed its opposition to the State of Nevada's Motion to Stay of all proceedings in the District Court pending a final decision in the U.S. Court of Appeals for the Ninth Circuit. The State of Nevada replied on March 12, 1990, with a brief and an answer. Presently, we are waiting for the Judge's decision regarding the plaintiff's Motion to Stay.

LEAD CANISTERS

Mr. Myers. Please highlight the findings of the Department regarding the use of lead in high-level nuclear waste disposal canisters.

Mr. Rousso. The following highlights DOE's findings based on literature survey, international studies, short term laboratory data, and Peer Review (including the International Lead Zinc Research Organization Inc.):

1. Although many results of the international studies of lead are useful in assessing potential applications, none of the foreign designs is directly applicable for the Yucca Mountain repository because of the significantly different environmental conditions expected.

2. In the context of the reference design for the expected unsaturated site, lead would be an inappropriate material for use as the principal containment barriers in comparison with any of the candidate materials (metals) currently under consideration primarily because of its poor mechanical and creep properties.

3. In the context of the alternative materials and designs that DOE plans to consider in the event unanticipated site conditions are encountered, lead offers characteristics and performance that could be useful. Lead may provide additional corrosion barriers, improved heat transfer capabilities, radiation shielding, and internal support for the container. DOE will give lead appropriate consideration with other viable alternative materials and design concepts, with the realization that an extensive developmental effort will be required before lead could be selected as the reference material.

4. On February 9, 1990, DOE transmitted a "Report to Congress on the Potential Use of Lead in the Waste Packages for a Geologic Repository at Yucca Mountain, Nevada," This report was prepared at the request of the House Committee on Appropriations in 1988 to evaluate the use of lead in high-level nuclear waste disposal canisters.

GRANTS AND FINANCIAL ASSISTANCE

Mr. Myers. What is the fiscal 1991 budget request for grants and financial assistance to non-federal entities in this program?

Mr. Rousso. For FY 1991, the Department is requesting $5 million for the State of Nevada and $5 million for the affected units of local government. The Department is also requesting $1.6 million for payment-equal-to-taxes. In addition, we are requesting $1.9 million to support grants for the Monitored Retrievable Storage program.

MONITORED RETRIEVABLE STORAGE

Mr. Myers. Please update the Subcommittee on the DOE review of a Monitored Retrievable Storage (MRS) site?

Mr. Rousso. The Nuclear Waste Policy Amendments Act authorized the Department to conduct a survey and evaluation of potentially acceptable sites subsequent to submittal of the Monitored Retrievable Storage Review Commission's report to the Congress. However, the Department prefers to pursue the second path authorized by the Amendments Act, which is to site the MRS through an agreement with a volunteer host. In this regard, the Department will be prepared to support the Nuclear Waste Negotiator whose appointment is expected shortly. The Department is also studying other alternatives that could potentially lead to an agreement with a volunteer host.

Mr. Myers. Have any states indicated interest in locating an MRS within their borders?

Mr. Rousso. I am not aware of any recent expressions of interest in hosting a monitored retrievable storage facility at the State level. The Department has, however, received inquiries from other entities.

ADVANCED LIGHT WATER REACTOR

Mr. Fazio. Mr. Young, would you please describe for the Committee the characteristics of a passively safe advanced light water reactor. If an advanced light water reactor experiences a loss of coolant, for example, would it have the same capability as the MHTGR to safely shutdown on its own, without a radioactive release?

Mr. Young. The Advanced LWR mid-size plants employ primarily passive means (such as gravity or natural circulation) to remove decay heat and provide emergency core cooling to prevent core damage, as well as to contain fission product activity even in the unlikely event of a core damaging accident.

The GE SBWR design features a natural circulation reactor. A gravity driven core cooling system, working in combination with an elevated pressure suppression pool and reactor depressurization valves, provides abundant cooling of the reactor basically by passive means in the event of a large loss-of-coolant accident. The isolation condenser facilitates reactor decay heat removal by natural circulation without use of the feed or steam systems. The DOE program includes the verification testing of these key features. Plant arrangement and construction studies were also performed to simplify and improve the constructibility of the plant.

The AP600 design employs significant simplifications and innovations in design, construction, and operation facilitated by the lower power rating. This concept features the application of canned motor reactor

coolant pumps to improve reliability and maintainability, elimination of reactor vessel bottom head penetrations, a passive containment heat removal system, and extensive use of prefabrication and modularization to improve constructibility.

As a result of these passive design features, the mid-size Advanced LWRs vulnerability to major loss-of-coolant accidents is extremely low. The reactor core remains covered with coolant, and the continuing natural response of the passive safety systems assures that it stays that way. It is conceivable that after several days of passive cooling some limited operator action may be required. The Modular High Temperature Gas Reactor (MHTGR) design has the potential of providing even greater use of passive safety features based primarily on the use of the very high retention capabilities of its graphite fuel. The proponents of the MHTGR believe that no operator action will be necessary in the event of a major loss-of-coolant accident. In our view, both the Advanced LWR and the MHTGR designs will provide a wide margin of safety to the public.

ADVANCED REACTOR FUNDING

Mr. Fazio. Does this increase in MHTGR funding and sharp decrease in LMR funding represent a shift in priorities within the Advanced Reactor R&D Program or does this shift reflect what has been anticipated from the start for these two programs?

Mr. Young. There has not been a shift in funding priorities for the Modular High Temperature Gas-Cooled Reactor (MHTGR) and Liquid Metal Reactor (LMR) programs. The MHTGR continues to be developed as a mid-term option and the LMR as a long-term option.

MODULAR HIGH TEMPERATURE GAS-COOLED REACTOR

Mr. Fazio. Is the requested funding level for MHTGR adequate to continue the research and development work and to achieve certification of this very promising reactor in a timely fashion?

Mr. Young. The requested funding augmented by new production reactor support for common technology tasks will be adequate to proceed with our planned research and development.

LIQUID METAL REACTOR FUNDING

Mr. Fazio. This Committee has restored the LMR funding in the past. Do you expect the Committee to restore these funds once again?

Mr. Young. We believe that the funds requested for the Liquid Metal Reactor (LMR) program are consistent with the development strategy planned for the LMR program. The conceptual design efforts emphasizing actinide conversion capability are scheduled for completion by January 1992. The Department is considering issuing a Request for Proposal on design optimization for actinide conversion in June 1993. Resolution of all key safety and licensing basis issues is targeted for January 1994. This strategy continues the LMR development as a long-term option that could be available after the turn of the century.

LIQUID METAL REACTOR

Mr. Fazio. How much money in FY 1991 is DOE requesting to help develop a standardized design for a large LMR?

Mr. Young. The Department of Energy is not planning any design activity for a large Liquid Metal Reactor (LMR). For the LMR R&D activities, the Department is requesting $5.0 million for the Power Reactor Inherently Safe Module design efforts, $10.0 million for the metal fuel cycle development, and $2.0 million for the actinide recycle initiative.

ADVANCED LIGHT WATER REACTOR R&D PROGRAM

Mr. Fazio. Why should DOE support a standardized design for a large LWR, when Secretary Watkins has indicated that no new nuclear power plants will be built until after the turn of the century?

Mr. Young. The timing and pace of new nuclear plant construction is being studied in conjunction with the development of the National Energy Strategy. The primary purpose of the large size plant program has been to firmly demonstrate the new design certification regulatory process needed for advanced light water reactors. This will be successfully achieved with the Nuclear Regulatory Commission Design Certification of the Advanced Boiling Water Reactor in late 1991. The earliest possible date for the first commercial order would be 1992, and this plant would not go into operation until 1999. It would be after the turn of the century before a significant number of such plants would go into operation.

LIGHT WATER REACTOR RESEARCH

Mr. Fazio. The Advanced Reactor Program supports research and development on the MHTGR and the Liquid Metal Reactor (LMR). I understand that DOE is considering using some of these advanced reactor funds, which have been used in the past solely for the MHTGR and LMR, for Light Water Reactor research. (DOE has a separate LWR R&D program--$31.5 million).

Is this true. If so, this appears inconsistent with the motivation for the Advanced Reactor Program and would you please explain DOE's thinking on this.

Mr. Young. We can assure you that we are not considering using any of the funds requested for development of the Modular High Temperature Gas-Cooled Reactor and the Liquid Metal Reactor for light water reactor research. Our funding request in FY 1991 for the light water reactor program is separate from the other two reactor concepts and is $31.5 million.

Mr. Fazio. Mr. Young, would you please describe for the Committee the characteristics of a passively safe advanced light water reactor. If an advanced light water reactor experiences a loss of coolant, for example, would it have the same capability as the MHTGR to safely shutdown on its own, without a radioactive release?

Mr. Young. The Advanced LWR mid-size plants employ primarily passive means (such as gravity or natural circulation) to remove decay heat and provide emergency core cooling to prevent core damage, as well as to contain fission product activity even in the unlikely event of a core damaging accident.

The GE SBWR design features a natural circulation reactor. A gravity driven core cooling system, working in combination with an elevated pressure suppression pool and reactor depressurization valves, provides abundant cooling of the reactor basically by passive means in the event of a large loss-of-coolant accident. The isolation condenser facilitates reactor decay heat removal by natural circulation without use of the feed or steam systems. The DOE program includes the verification testing of these key features. Plant arrangement and construction studies were also performed to simplify and improve the constructibility of the plant.

The AP600 design employs significant simplifications and innovations in design, construction, and operation facilitated by the lower power rating. This concept features the application of canned motor reactor coolant pumps to improve reliability and maintainability, elimination of reactor vessel bottom head penetrations, a passive containment heat removal system, and extensive use of prefabrication and modularization to improve constructibility.

Mr. Fazio. Some of those involved in the advanced light water reactor program have indicated a capacity to start construction on a new, medium-sized nuclear reactor as early as 1995, if the Department of Energy participates, on a cost-share basis, in some of the fabrication engineering work. Mr. Young does the Department share this goal and to what degree is the Department willing to participate in such an initiative (--in FY 91 and overall?).

Mr. Young. The engineering to be accomplished on the Westinghouse AP600 and General Electric Simplified Boiling Water Reactor plants in our new simplified passive plant program will complete a major part of the plant detailed design. However, a substantial amount of additional first-of-a-kind engineering to provide the needed modular construction and prefabrication capabilities must be accomplished before the first plant can be built. This work also will be needed to facilitate turnkey (or fixed price) offers to stimulate the consideration of these plants in the marketplace.

From our initial review, we believe that it would be appropriate for the Department to participate in a cooperative arrangement with the nuclear industry to complete this first-of-a-kind engineering. However, further discussion and coordination with the nuclear industry are required to develop the best approach, participants, options, equitable cost share arrangements, and other key factors that must be defined for a cooperative program of this type to be effective. We are not yet to the point where we have included this in our FY 1990-1991 budget request.

Mr. Fazio. How much has the Department of Energy spent over the years on its various projects at TMI?

Mr. Young. The total cost of the DOE Three Mile Island Unit 2 (TMI-2) research and development program has been about $188 million. Funding of research and development of means to disassemble and defuel the reactor and process the waste materials was approximately $105 million, with the remaining $83 million devoted to research on the accident and its consequences. The total cost of the cleanup of the TMI-2 is expected to be close to $1 billion.

Mr. Fazio. You have indicated that GPU Nuclear Corporation expects to complete defueling of the core debris in March 1990 with completion of the debris shipments in April 1990. Where is this waste being transported to and is this a temporary or permanent storage arrangement?

Mr. Young. The Three Mile Island Unit 2 core debris waste is being shipped to the Idaho National Engineering Laboratory for temporary storage and research. The plan is to eventually ship this waste to the national waste repository.

RANCHO SECO DECOMMISSIONING

Mr. Fazio. In January, I had the opportunity to tour the Ranch Seco nuclear facility owned by the Sacramento Municipal Utility District (SMUD). As my colleagues are aware, Rancho Seco was shut down by a vote of the local populace last June, 1989. As a result of that referendum, SMUD faces the immediate task of developing and executing a plan to decommission a 900 megawatt nuclear power plant. This challenge comes a lot more quickly than SMUD, or the nuclear industry, or the NRC had anticipated. It casts SMUD in the not altogether welcome role as a decommissioning "pioneer."

We are told by the NRC that the technology currently exists to decommission a nuclear power plant the size of the Rancho Seco facility. The federal government, through the Department of Energy, participated in the recent decommissioning of the Shippingport reactor, and it is hoped that the lessons learned there will be widely disseminated and used by others in the industry. DOE also participated in the cleanup of the Three Mile Island reactor, and the knowledge gained from that experience may prove useful in the decommissioning process.

We believe that the technology used at the 72 megawatt Shippingport reactor is applicable and transferable to the 900 megawatt Rancho Seco plant -- but we are not certain. We think the technology is available, for example, to cut up a large reactor vessel, but it has never been demonstrated. Also, we are uncertain about the implications of the fact

that Rancho Seco has significantly higher curie content and more contaminated piping and equipment than was found at Shippingport.

I believe, the Rancho Seco decommissioning can provide important R&D opportunities for DOE and the entire nuclear industry. It is my understanding that significant knowledge may be gained in areas such as the use of robotics in high radiation areas, dust and effluent control during sectioning of a reactor vessel, and volume reduction of low level waste.

The simple fact is that the decommissioning of Rancho Seco will be a demonstration of the technology that the NRC says exists. It is my hope that we can make a successful demonstration, one that produces valuable information for other utilities and the entire U.S. nuclear industry.

I have spoken with Henson Moore and communicated with some of your staff about my desire to see DOE investigate areas where the Department might be able to participate with SMUD, the nuclear industry, even foreign interests, in a project to demonstrate these technologies. The best way to identify those areas where additional R&D might be needed may be through a study and I would like to work with you on that. But I do have some questions on this that I would like to raise with you today.

Isn't it the case, Mr. Young, that ratepayers served by other utilities that own and operate nuclear power plants would benefit if there were better definition of the costs and procedures associated with decommissioning a large nuclear reactor?

Mr. Young. The technology for decommissioning nuclear reactors is reasonably well established. The Nuclear Regulatory Commission in its final generic environmental impact statement has concluded that such decommissioning can be performed safely and at reasonable cost. Certainly, I would agree that each time another closed plant, such as Rancho Seco, is decommissioned, we will obtain a better definition of costs and procedures. This increase in knowledge will be an incremental one, and will benefit other utilities when they have to decommission their plants.

Mr. Fazio. Has the technology to decommission a plant the size of Rancho Seco been proven?

Mr. Young. The basic technology to decommission power reactors is largely proven. There are certainly some different considerations involved in different sized plants, different types of reactors, etc. However, we do not expect these to be of a nature that would require new research and development efforts.

Mr. Fazio. Does the Atomic Energy Act create any barriers to DOE participation in a R&D initiative involving the decommissioning of Rancho Seco?

Mr. Young. The Act provides very broad authorities for the Department to participate in energy research and development programs. Thus, it is very unlikely that it would create any barriers to DOE participation in an R&D activity involving decommissioning a reactor like Rancho Seco, assuming that a convincing case is made for the value of the information to be gained from such a program.

Mr. Fazio. Describe the most significant lessons learned from the Shippingport project?

Mr. Young. A good summary, including lessons-learned, of the Shippingport Station Decommissioning Project is the final project report (DOE/SSDP-0081). The objective of this project was to demonstrate safe and cost effective dismantlement of large full scale nuclear fueled electric powerplants, to optimize the number of subcontractors to induce a transfer of decommissioning experience to the nuclear industry, and to provide for technology transfer by generation of project performance data and documentation of decommissioning experience for use in future decommissioning projects.

Four major lessons-learned were: 1) the reactor pressure vessel one-piece removal is a cost-effective and practical procedure; 2) the nuclear industry's present labor force and management can undertake decommissioning with no need for huge sums of money nor extended application of manpower and effort; 3) management's strict attention to ALARA (as low as reasonably achievable) practice, planning, and scheduling leads to reductions of occupational radiation exposure and concurrently to efficient removal of radioactive components; and 4) existing equipment and technology can easily accomplish decommissioning.

Mr. Fazio. How many of these lessons learned could be helpful as Rancho Seco is decommissioned?

Mr. Young. In a general sense, most of the lessons-learned from the Shippingport decommissioning project should be of substantial benefit to any future decommissionings, such as Rancho Seco. Of course, each reactor facility will have certain differences associated with it, so some modification of the methods and approaches used successfully at Shippingport will be required. But the basic technology developed at the Shippingport site should be applicable.

Mr. Fazio. What technological advancements were made during the decommissioning of Shippingport?

Mr. Young. Considerable effort was devoted to documenting the technological advancements made as a result of decommissioning Shippingport. These are described in the Final Project Report for the project, as well as a host of topical reports. Advances were made in areas like asbestos removal; irradiated component removal; primary systems, piping, and equipment removal; decontamination; contaminated concrete removal; concrete structures removal; reactor pressure vessel preparation; and reactor pressure vessel removal, transportation, and burial.

Mr. Fazio. Please describe the difference between the Shippingport pressure vessel and the one at Rancho Seco in terms of size, length of operation, levels of radioactive contamination, etc.

Mr. Young. The Shippingport Reactor Pressure Vessel (RPV) package consisted of the RPV and Neutron Shield Tank (NST) along with a lifting beam and skirt suitable for a single unit lift. The RPV/NST package was a right circular cylinder with a hemispherical bottom head. The RPV/NST package was approximately 41 feet in length and 18 feet in diameter. The outer component was the steel neutron shield tank with 1 inch thick steel walls. The inner component was a 8-3/8 inch thick steel shell that formed the RPV cavity. The NST annular space (35 inches wide by 252 inches in length) and the reactor cavity (109 inches in diameter by 314 inches in length) were filled with light-weight concrete after non-fuel reactor internal components were replaced in the RPV.

The Shippingport reactor operated from 1957 to 1982 at varying power levels. When shipped in 1989, the weight of the RPV package was 1,798,000 pounds, and it contained about 16,500 curies.

The Rancho Seco vessel is, of course, of the type more commonly used in later commercial light water reactor plants. Typically, such vessels measure about 40 feet in height and up to 16 feet in diameter, and are made of carbon steel 8-10 inches thick lined with stainless steel. The Rancho Seco 918 MWe reactor plant operated at varying power levels from 1975 to the late 1980s. We do not have any specific information on the levels of radioactivity associated with the vessel.

Mr. Fazio. Would DOE be willing to take the spent fuel from Rancho Seco?

Mr. Young. DOE presently has no plans or capabilities for taking the spent fuel from Rancho Seco.

Mr. Fazio. What options do you believe that Rancho Seco has for getting rid of its spent fuel?

Mr. Young. It is the responsibility of the Sacramento Municipal Utility District to develop and implement the best approach for dealing with the spent fuel from their Rancho Seco plant. The approval of the Nuclear Regulatory Commission will, of course, be necessary whatever approach is taken. Some possible options that might be considered are: transfer to some other utility or utilities, transfer to the Morris, Illinois storage facility, dry cask storage at Rancho Seco, or segregating the spent fuel pool at the Rancho Seco plant from the reactor in a manner acceptable to regulatory authorities.

REDUCED ENRICHMENT IN RESEARCH AND TEST REACTORS

Mr. Fazio. What is the current level of U.S. highly-enriched uranium (HEU) exports to foreign research and test reactors? Which reactors received these exports? Is low-enriched uranium (LEU) fuel developed under the Reduced Enrichment in Research and Test Reactors (RERTR) program available for use in these reactors? If so, why did the United States export HEU?

Mr. Young. We exported approximately 202 kilograms of uranium at 93 percent enrichment and 180 kilograms of uranium at 45 percent enrichment in FY 1989 and expect to deliver approximately 201 kilograms of uranium at 93 percent enrichment and 107 kilograms of uranium at 45 percent enrichment in FY 1990.

Reactors receiving highly enriched uranium (HEU) in FY 1989 and FY 1990 are shown below. All but four of the 45 foreign research and test reactors (power equal to or greater than 1MW) currently involved in the program are either in the process of converting, or are able to convert, with the fuels already developed. Of the four unable to convert, one has a life-time supply of fuel and the other three (two in France and one in Belgium) would require a highly developmental, new fuel system. The conversion process takes time and involves a number of steps including operational and safety analyses, regulatory reviews, fabrication of fuel, and sometimes minor reactor modification. An assured supply of fuel is

needed for continued operation of the reactors involved until conversion can be accomplished.

FY 1989 Recipients of HEU

Country	Reactor	Reason for Export
Belguim	BR-2	Suitable LEU Fuel Not Currently Available
Netherlands	HFR Petten	Currently Testing LEU Prototype Elements
France	RHF Grenoble	Suitable LEU Fuel Not Currently Available
France	Orphee	Suitable LEU Fuel Not Currently Available
Germany	BER-2	Last HEU Export before Conversion to LEU
Japan	JMTR	LEU Licensing Issues Being Resolved
Japan	JRR-2	To Be Shutdown in early-mid 1990s

Expected FY 1990 Deliveries of HEU

Country	Reactor	Reason for Export
Belgium	BR-2	Suitable LEU Fuel Not Currently Available
Netherlands	HFR Petten	Currently Testing LEU Prototype Elements
France	RHF Grenoble	Suitable LEU Fuel Not Currently Available
France	Orphee	Suitable LEU Fuel Not Currently Available
Canada	NRU	Last HEU Export before Conversion to LEU
Japan	JMTR	LEU Licensing Issues Being Resolved
Japan	JRR-2	To Be Shutdown in early-mid 1990s

REDUCED ENRICHMENT IN RESEARCH AND TEST REACTORS

Mr. Fazio. What level of funding would have to be made available in FY 1990 through reprogramming to allow the RERTR program to continue on schedule for completion in 1994? What level of funding is required annually through 1994?

Mr. Young. No reprogramming of FY 1990 funds is necessary. We believe the fuels development work is complete. As I have indicated, continued funding for the type of assistance carried out in FY 1990, technology transfer and conversion assistance, for FY 1991-94 would be appropriate.

REDUCED ENRICHMENT IN RESEARCH AND TEST REACTORS

Mr. Fazio. What will be the effect of cancellation of the RERTR program on foreign reactor conversions? Hasn't the U.S. been advised by some operators of foreign research reactors that they will not convert to LEU fuel unless all research reactors convert, including U.S. DOE civil reactors and licensed domestic research reactors?

Mr. Young. I expect that conversion of foreign reactors will proceed in an orderly fashion using the technology developed in the program and believe that foreign conversion programs are not significantly influenced by actions of the U.S. and other countries. Each country's decisions to convert and the pace of conversion, are more likely to be influenced by the costs to convert and impact on reactor test capabilities.

REDUCED ENRICHMENT IN RESEARCH AND TEST REACTORS

Mr. Fazio. How many foreign research reactor operators likely will not convert to already-developed LEU fuels because of the absence of technical support from the RERTR program staff?

Mr. Young. Funds are included for FY 1991 under the Office of International Affairs and Energy Emergencies budget account for continuing technology transfer and conversion assistance.

REDUCED ENRICHMENT IN RESEARCH AND TEST REACTORS

Mr. Fazio. In 1986, the Nuclear Regulatory Commission ordered operators of licensed domestic research reactors to convert to the low-enriched fuels, due to security concerns over the continued civilian commerce in bomb-grade material. How many are now proceeding with conversion? How many are not? How many have been granted exemption from the NRC order to convert to LEU fuels.

Mr. Young. The NRC rule requires conversion of specific reactors pending availability of necessary funds from DOE under the University Assistance Program. NRC orders to convert are not issued until funds are available. Of the 17 reactors that are candidates for conversion, 4 have converted, 9 are in the process of being converted, leaving 4 to be converted. The 4 reactors not yet scheduled for conversion are TRIGA reactors that use a different fuel system that is more expensive to convert to LEU fuel than the plate-type fuels by a factor of 2 to 3 times.

There are two reactors, one at the Massachusetts Institute of Technology and the other at the University of Missouri that are exempt from conversion because of a requirement for higher performance fuels which have not been developed.

REDUCED ENRICHMENT IN RESEARCH AND TEST REACTORS

Mr. Fazio. Is the level of DOE funding of the domestic conversion program adequate to enable the timely conversion of these reactors?

Mr. Young. The conversion of university reactors is conducted under the University Assistance Program. This program was recently transferred from the Office of Energy Research to the Office of Nuclear Energy. Steady progress is being made. As previously discussed, there are a total of 17 reactors that are candidates for conversion. Four of these have been converted and nine are in the process of converting. Conversion of the remaining four is yet to be started. Plans are to complete conversion of these remaining reactors at a rate of two to three a year. This schedule will be reexamined during the FY 1992 budget formulation process.

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REDUCED ENRICHMENT IN RESEARCH AND TEST REACTORS

Mr. Fazio. To what extent does the domestic reactor conversion program rely on the expertise of the RERTR program to enable conversion? What would be the effect on the domestic program if the RERTR program is terminated during this fiscal year?

Mr. Young. Under the University Assistance program, members of the Argonne RERTR program staff have and are continuing to support efforts by the universities to do safety analyses, design reviews, and preparation of fuel specifications. These efforts are funded not by the RERTR program but separately under the University Assistance program. The status of the RERTR program itself would not have any effect on the support activities to the universities.

REDUCED ENRICHMENT IN RESEARCH AND TEST REACTORS

Mr. Fazio. What level of funding would have to be made available in FY 1990 through reprogramming to allow the RERTR program to continue on schedule for completion in 1994? What level of funding is required annually through 1994?

Mr. Young. We believe the fuels development work is complete. As I have indicated, continued funding for the type of assistance carried out in FY 1990, technology transfer and conversion assistance, would be appropriate.

STANDARDIZED DESIGN

Mr. Fazio. How much money in FY 1991 is DOE requesting to help develop a standardized design for a large LWR?

Mr. Young. The FY 1991 budget request contains $0.5 million to complete the work on certification of a standardized design for a large Light Water Reactor.

NUCLEAR FISSION

Mr. Chapman. Mr. Young, you state (on p. 2 of your statement) that "nuclear power can play an important role in maintaining a balanced and secure energy supply for the United State's domestic electrical power, space and military needs." Please elaborate on what role we realistically can expect nuclear power to play in the near term in the National Energy Strategy, in light of continuing licensing difficulties and public opposition to nuclear power.

Mr. Young: In the near term we expect nuclear power to continue to play an important role in meeting U.S. electricity needs, by providing approximately 20 percent of the Nation's electricity from existing nuclear plants.

The next order for a nuclear powerplant is expected in the early to mid-1990s. This projection is based on the following assumptions:

- The next plant is expected to be an Advanced Light Water Reactor (ALWR), following Nuclear Regulatory Commission certification of the large (approximately 1300 MWe) evolutionary plant in 1991, and the mid-sized (600 MWe) simplified, passively safe plant in 1995. The specific type of ALWR ordered will depend upon individual utility needs and experiences.

- Utilities will continue to be confident that the Federal Government will honor its legal responsibility to accept commercially generated spent fuel on a timely basis.

- The NRC Standardization Rule of April 1989 will be improved, resulting in early resolution of emergency planning issues for new nuclear plant sites, and reduction or elimination of the possibility of a post-construction licensing hearing.

- Current plants will be operated safely, more and better factual information will be made available to the public concerning nuclear power, leading to broader recognition of nuclear power as an attractive response to environmental concerns than associated with other forms of electricity generation.

- Regulators, utilities, and non-utility firms will work together to clarify who is to bear responsibility for what risk associated with the development of new generating capacity (e.g., uncertainty over electricity demand growth, construction costs, regulatory decision schedules, fuel costs, and plant operating efficiency), and how risk-bearing is to be rewarded.

- New nuclear plants will have an expected busbar generation cost that will be competitive with other baseload generation alternatives.

Mr. Chapman. You note in your testimony (p.2 and p.8) that the Department supports future plant life extensions program for more than 100 reactors with an additional 20 years of operating life. How many nuclear power plants have the potential for an extended lifespan of at least 20 years?

Mr. Young. We believe essentially all of the operating plants have the potential to extend their operating service life if the regulatory policy and standards currently being considered are incorporated by the NRC in their rulemaking for license renewal. Today there are few policies, rules, or standards to guide the decisions by licensees or the NRC on the length of the license extension. Also, in addition to these decision factors, the utility decision on the length of the plant life extension will involve alternative generation options, demand for power, prior plant operating history, and the utility business structure. Although these other factors are important, the major factor will be the regulatory requirements imposed by the NRC.

Mr. Chapman. How closely is the DOE coordinating with the NRC on both improving on nuclear plant standardization and licensing and extending existing plant life?

Mr. Young. DOE maintains direct and indirect interfaces with the NRC to ensure that both agency activities are being coordinated. Substantial interaction has already occurred with the submittal and NRC review of the two large plants, the General Electric Advanced Boiling Water Reactor and the Combustion Engineering System 80+. This same approach will be followed in the submittal for NRC review of the two mid-sized light water reactors.

In the case of the plant lifetime extension program, the direct coordination activities involve DOE and NRC exchanges of program plans, schedules, and project write-ups. Also, through respective program managers, weekly communications on status and future direction occur, including periodic technical exchange meetings or interim project results. In addition to these direct interfaces, indirect coordination occurs through DOE interaction with the Nuclear Management and Resources Council (NUMARC) Nuclear Utilities Plant Life Extension Working Group (NUPLEX) and the Electric Power Research Institute (EPRI). The NUMARC NUPLEX has formal agreement with the NRC to provide the utility industry technical and institutional position on life extension and license renewal. EPRI provides the technical positions to NUMARC. We have agreements with and support development of the EPRI technical positions and the NUMARC institutional position. Through the direct and indirect interaction we are able to ensure that the necessary coordination of the NRC, DOE, EPRI, and NUMARC programs occur.

SPACE/DEFENSE POWER SYSTEMS

Mr. Chapman. The Department is requesting an increase of approximately 76% over last year's appropriation for the Space Reactor Power Systems. What major breakthroughs have occurred recently in this program?

Mr. Young. The SP-100 Space Reactor Program, the principal element of the Space Reactor Power System Program, has achieved several milestones and key accomplishments during the past year, including a technical breakthrough in the thermoelectric converter. The first complete multicouple cell was fabricated and tested in 1989, demonstrating a 10-fold increase in power density over existing, similar sized thermoelectric devices. Further development of these devices will continue in FY 1990 and 1991, with a doubling of power density, over what was recently demonstrated, expected by the end of FY 1991.

A major programmatic event was a recommitment of user agency support and outyear funding through FY 1994 by all of the sponsoring agencies. In the fall of 1989, DOE, DOD, and NASA signed an amended Memorandum of Agreement, which provided sufficient outyear funding to proceed with the nuclear assembly test demonstration at the Hanford, Washington, test site. Another important programmatic event was the identification by NASA of space nuclear surface power as a critical technology need for the

President's Human Exploration Initiative. For example, space reactor power systems may be required for surface power for any significant lunar outpost because of the long (14-day) lunar nights. SP-100's first application may very well be for surface power for lunar outposts.

There have been several other key technical accomplishments. For example, the difficult fabrication process of bonding different refractory metals into tubing was recently demonstrated and is currently being qualified for production of fuel cladding tubes for the SP-100 ground demonstration reactor. The SP-100 reactor mockup tests in the Zero Power Physics Reactor were successfully completed and analyzed; and SP-100 fuel pins have been irradiation tested to beyond the goal burnup level of 6 atom percent without any harmful degradation.

Finally, the SP-100 environment assessment was completed and a Finding of No Significant Impact (FONSI) issued for the SP-100 Ground Engineering System Test site. This is one of the major milestones that had to be completed for construction modifications of the test site to begin on schedule in 1991.

MARKET SHARE

Mr. Chapman. You note (p. 32 statement) that the U.S. currently holds 50% of the commercial world enrichment market. Is it the Department's position that the U.S. market share will erode further without privatization of the enrichment enterprise?

Mr. Young. It is the Department's view that its U.S. and world market shares will erode further without the commercial flexibilities and characteristics attendant with the proposed Government-owned enrichment corporation. Immediate, total privatization of the uranium enrichment enterprise is not necessary at this time to reverse the declining trend in market share. On the other hand, the enrichment enterprise believes that, as a Government agency, sufficient reforms are not possible to permit it to succeed against competitors with commercial organizations and incentives.

U.S. URANIUM ENRICHMENT CORPORATION

Mr. Chapman. The DOE proposes a government-owned enrichment corporation. Is the Department's goal total privatization of uranium enrichment?

Mr. Young. The Administration believes that the enrichment enterprise's functions are predominantly commercial in nature and that these would best be performed by a commercial entity. As a practical matter, we do not believe that privatization can be achieved until the uranium enrichment enterprise has demonstrated a track record of sound business and financial performance with a strong future earnings potential. It is felt that establishing a Government-owned enrichment corporation can best meet this objective and then provide the basis upon which ultimate privatization can be achieved.

LITIGATION

Mr. Chapman. When do you anticipate a decision in the suit by the Department of Justice and DOE against the State of Nevada to require the State to process DOE's permit applications?

Mr. Rousso. The District Court in this case is currently considering a motion by the State of Nevada to stay these proceedings until the lawsuit that the State initiated in the Court of Appeals is resolved. The Department's current schedule for initiating surface-based testing activities at Yucca Mountain depends upon the resolution of this permit issue by January 1, 1991.

EXPLORATORY SHAFT

Mr. Chapman. The Department's request anticipates sharply escalating costs for the exploratory shaft in Fiscal Years 1991, '92 and '93, yet there is continuing difficulty in commencing non-surface work. Please explain the Department's goals in this area in the near term.

Mr. Rousso. We expect to receive the needed environmental permits by late 1990. Between now and the start of Exploratory Shaft Facility (ESF) construction, we are reevaluating, in accordance with all applicable quality assurance and Nuclear Regulatory Commission requirements, the locations chosen for the exploratory shafts, the method chosen for the construction of the shafts, the means of access (ramps or shafts) to the repository horizon, the need for additional exploratory drifts, and the design of the shafts and other components of the ESF. Requests for the reevaluation of shaft location and design have come from the NRC staff, while the suggestions to reconsider the means of access, the shaft construction method, and the need for additional drifts came from the Nuclear Waste Technical Review Board. These studies will be completed this year. In 1991, procurement of some long lead-time equipment will begin. We are currently evaluating the potential for beginning exploratory shaft construction several months earlier than the present schedule of late 1992.

PROGRAM SCHEDULE

Mr. Chapman. When does the Department expect the permanent repository to be fully operational?

Mr. Rousso. Based on the reference schedule for the restructured program submitted to the Congress in November 1989, the repository will start receiving waste for disposal in January 2010. It is anticipated that the repository will attain its full yearly capacity of 3,400 metric tons of heavy metal per year in five years (by 2015) after a gradual ramp-up.

MONITORED RETRIEVABLE STORAGE

Mr. Chapman: Please explain more fully the role of a monitored retrievable storage (MRS) facility in the waste disposal system.

Mr. Rousso: The monitored retrievable storage (MRS) facility is as an integral component of the waste disposal system. The MRS facility, unlike a geologic repository, would be an engineered above ground facility, based on currently licensed spent fuel storage technology. Consequently, its implementation schedule is more certain and it will be able to accept more spent fuel in its initial years of operation than a repository. Because of this, the waste system with an MRS would be able to provide the utilities a more certain and adequate basis to schedule the transfer of spent fuel to the Federal Government. As currently viewed, the MRS would also provide the Federal waste management system up to 15,000 MTU storage capacity; this would allow the waste management system to accommodate irregularities in the schedule for repository development or waste emplacement without impacting the scheduled receipt of spent fuel from the utilities.

Mr. Chapman: What factors (geologic, demographical, etc.) does the Department consider in siting a MRS facility?

Mr. Rousso: Any proposed agreement developed by the Negotiator and a potential MRS host must be enacted into law before it would become effective. For an MRS site to be licensed by the Nuclear Regulatory Commission (NRC), it would need to comply with the siting considerations promulgated by the NRC for such facilities. These include frequency and severity of external natural events and man induced events that could affect the safe operation of the MRS, the potential for radiological and other environmental impacts on the region, with due consideration of the characteristics of the population and the regional environs, and avoidance of long-term and short-term adverse impacts associated with the occupancy and modification of flood plains.

As noted previously, the Department prefers that the MRS facility be sited through the efforts of the Nuclear Waste Negotiator, who is to attempt to find a State or Indian tribe willing to host an MRS at a technically qualified site on reasonable terms.

DOE UNIVERSITY PROGRAM IN ROBOTICS FOR ADVANCED REACTORS

Mr. Pursell. What level of support has DOE proposed for the University Robotics program in FY 1991?

Mr. Young. The Department of Energy has not requested funds for the University Robotics Program in FY 1991.

Mr. Pursell. Do you support the Administration's position in this regard?

Mr. Young. Yes. Nearer-term and higher priority activities must continue to take precedence for budget requests.

DOE UNIVERSITY PROGRAM IN ROBOTICS FOR ADVANCED REACTORS

Mr. Pursell. The Universities present a status report to Oak Ridge annually. Are Oak Ridge officials pleased with the results to date?

Mr. Young. The Oak Ridge National Laboratory serves as the University consortium coordinator and is responsible for integrating the diverse technologies developed at the individual universities into a robot demonstration on an annual basis. The last such demonstration, a mobile robot navigating through an obstacle-strewn course to clean up a simulated radioactive spill, was flawlessly executed before Oak Ridge officials and others on February 27 of this year.

I believe that the Oak Ridge coordinators are pleased with the results of the program to date.

Mr. Pursell. Several other nations - Japan, Germany and France - have strong projects in nuclear powerplant robotics. The Japanese budget in FY 1988 was $9 million, while the U.S. budget in FY 1988 for the University Robotics program was only $2.7 million. Do you believe the U.S. is falling behind other nations in developing this technology?

Mr. Young. I believe that the U.S. will continue to be competitive in the development of the next generation of advanced, or autonomous, robotic systems. I also believe the next most likely large scale effort in, and application of, the developing field robot technology in the nuclear area would be in the cleanup of Federal hazardous and nuclear waste sites. In this regard, we have initiated discussions with other Federal groups to determine their interest in utilizing the work accomplished in the University Robotics program as a base from which to complete their defined needs. Near-term program priorities in nuclear energy are focused on activities to help remove institutional impediments to any new reactor and must take precedence over long-term research on specific applications of autonomous robotic systems to advanced nuclear reactor plants.

Mr. Pursell. Do you agree that a robotics program would be a great asset to this nation's future in nuclear power?

Mr. Young. Programs that address reductions in human exposure from potentially hazardous environments in and around nuclear powerplants, that could provide a faster, cheaper and better way of overcoming nuclear facility environmental clean-up problems and could provide for technology transfer to other U.S. industries would potentially be a great asset to this nation's future in nuclear power.

Mr. Conte. What effect does the Department feel that the recent licensing of Seabrook will have on nuclear plant production in the United States? Will it unleash a torrent of applications for new starts?

Mr. Young. Although the licensing of Seabrook may not have any immediate, large positive effect on the future of the nuclear option, it would have had a negative effect if it had not been licensed. This long-delayed licensing action demonstrates once again that nuclear power is considered to be an important energy option by the electric utility industry, even in cases where tremendous obstacles must be overcome.

However, we as a Nation must find a way to make the licensing process more efficient. Nearly two decades to license a nuclear plant costing in excess of $6 billion is unacceptable. Congress needs to consider nuclear licensing reform legislation on a priority basis if there is to be a revitalization of the U.S. nuclear option.

Mr. Conte. Please provide a brief update on the Department's efforts to standardize nuclear plant designs.

Mr. Young. The Department's efforts to standardize nuclear plant designs are proceeding very well. The work on the large-size Advanced Boiling Water Reactor is nearing completion, and we are confident that our milestone of obtaining Nuclear Regulatory Commission (NRC) design certification by late 1991 will be met.

With respect to the Advanced Pressurized Water Reactor (APWR), the original certification effort was based on Combustion Engineering submittal of only the nuclear island portion of their System 80+ plant. The NRC subsequently changed their rules to require submittal of the full plant scope; this created a need for additional funds. We are currently exploring various ways to provide additional funding and will inform the cognizant Committees at the appropriate time relative to these efforts. If successful, the APWR standard design could be certified in 1992.

We are also pursuing efforts on two mid-sized standard design reactors: the Westinghouse AP600 and the General Electric Simplified Boiling Water Reactor. Results to date of conceptual design and features testing have been very good, and we are now moving forward with detailed design and development, with a goal of obtaining NRC certification by 1995.

SPENT FUEL DISPOSAL AND FUTURE NUCLEAR PLANT ORDERS

Mr. Conte. Although nuclear power appears to have made some public relations gains due to fears about global warming, there remains the nettlesome problem of nuclear waste disposal. How are delays at Yucca Mountain affecting the expansion of the nuclear industry in the U.S.? Does industry feel that it is essential that monitored retrievable storage capabilities be developed as a condition for industry growth?

Mr. Young. A perception by the nuclear utility industry that the U.S. Government may not be able to accept spent fuel in 1998 is a major factor in inhibiting consideration of new nuclear plants by utilities. It is our understanding that the utilities definitely want a monitored retrievable storage capability to become available by 1998 and that they are very sensitive as to whether there is a serious good faith effort being made to achieve measurable progress toward this objective. The utilities are also very concerned how the State public utility commissions would view proposed new nuclear plant projects if it appears that the Government would not be able to accept spent fuel starting in 1998.

INTEGRAL FAST REACTOR

Mr. Conte. I understand that one advantage of the Integral Fast Reactor is its capacity to reprocess actinides, highly radioactive particles. Please explain in layman's terms how this is accomplished. Also, please describe the principal obstacles to development of a reactor that promises such a major advantage.

Mr. Young. High level nuclear waste has two major components--fission products and transuranic, or actinide, elements. From the viewpoint of long-term radiologic risk, actinides are of dominant importance. The Argonne National Laboratory is developing a compact, low-cost metal fuel recycle process that shows promise for removing nearly all of the actinides from liquid metal reactor spent fuel, recycling these actinides as fuel into the liquid metal reactor, and converting them into useful energy and fission products.

The Department plans to initiate an actinide recycle effort in FY 1991. This effort is focused on determining those processes that can be used to remove actinides from spent light water reactor fuel, capitalize on the potential of the metal fuel recycle process, and utilize these light water reactor "wastes" as fuel feed for a liquid metal reactor.

At this point, there do not appear to be any technical obstacles to the development of this technology.

URANIUM-ATOMIC VAPOR LASER ISOTOPE SEPARATION

Mr. Conte. The Department has stated that, the "principal objective of the AVLIS (Atomic Vapor Laser Isotope Separation) program is to develop an advanced technology option that can enrich uranium at a cost significantly less than that of gaseous diffusion plants (GDPs) and of foreign competitors." Are there other significant advantages to AVLIS besides cost effectiveness?

Mr. Young. Yes, there are several environmental advantages. The first major environmental difference is the amount of electrical energy required to produce enriched product; the Uranium-Atomic Vapor Laser Isotope Separation, U-AVLIS, process uses about 10 percent of that required by gaseous diffusion. This has the advantage of significantly reducing the effluents associated with recirculating water cooling towers at the enrichment site and more significant is the reduction in SO2 and NOx emissions at the sites that produce the electrical power for the diffusion plants.

A second major environmental difference is in the fuel cycle. The gaseous diffusion plants use uranium hexafluoride as the uranium feed stock material while U-AVLIS will use uranium metal as the feed stock material. These feed stock changes will eliminate the fluoride waste disposal and eliminate the risks associated with the accidental release of toxic fluoride, hydrogen fluoride and uranium hexafluoride.

MARKET SHARE

Mr. Conte. Please briefly describe the state of international competition for uranium enrichment services.

Mr. Young. There are four major suppliers of commercial uranium enrichment services in the world today. With approximately half the world market, the Department's Uranium Enrichment Enterprise is the leading enricher. Two state-backed European consortia, EURODIF and URENCO, along with the Soviet Union, share the remainder of the market.

Today, the combined production capacity of these producers exceeds world demand by almost 50 percent. The growth of nuclear power over the next 10 years is not expected to be of sufficient magnitude whereby demand will be equal to the total supply of enrichment capacity. Nevertheless, for a variety of reasons, efforts to increase production capacity are proceeding. For example, we expect Japan to start up an indigenous commercial capacity before the end of the 1990s. URENCO has announced plans to construct and operate a 1.5 million separative work unit, SWU, per year plant in Louisiana by the mid-1990s, with the capability of doubling that capacity if warranted.

These factors have created a strong buyer's market, with fierce competition for uncommitted business among enrichment services suppliers. The highly competitive nature of the market is one of the major reasons why the Administration is seeking to establish a more effective organization to manage the Department's uranium enrichment enterprise.

NUCLEAR FISSION

Mr. Conte. What impacts has sequestration had on the Department's Nuclear Fission program in FY 90?

Mr. Young. The final sequestration amounted to only 1.4% of our budget and had no significant impacts to our programs.

NUCLEAR WASTE FUND

Mr. Conte. I understand that the Department is engaged in litigation with the State of Nevada over the issuance of permits to allow the Department to proceed with site characterization activities at Yucca Mountain. One issue in this case is whether Congress, through inaction, has effectively vetoed its earlier selection of Yucca Mountain as the sole site at which to proceed with site characterization activities. Is this correct? If Nevada prevails on this question, then what would become of the appropriation from the Nuclear Waste Fund for site characterization activities? Would you ask for a recision (sic)? Why isn't this budget request premature given the current state of litigation?

Mr. Rousso. In November 1989, we announced that if Nevada did not act on the permits for which DOE had applied, we would sue the state. The State of Nevada responded by filing its own lawsuit, claiming that the State has the right to bar DOE from carrying out Congress's mandate because the State legislature has "disapproved" the Yucca Mountain site. The State asserts that since Congress has not taken action to override the State resolutions "disapproving" the Yucca Mountain site, DOE's permit applications are "moot".

The suit filed on behalf of the Department contends that the State's claim to have "disapproved" the Yucca Mountain site is premature and without legal merit, since Yucca Mountain has not been recommended to the President, or by the President to the Congress, as a site for the repository. Under

the Nuclear Waste Policy Act, disapproval of the site selection by a situs State may only follow the recommendation of the President to the Congress. Thereafter, the Congress may override the State's disapproval.

While it is true that a successful Nevada suit could bar further work at Yucca Mountain, the Department is quite optimistic that the Federal case will prevail. Therefore, at this time, I feel that it is premature to discuss a budget rescission. Lack of permits has delayed surface-disturbing work but has not disrupted the extensive preparatory work and the many scientific investigation activities to be continued at Yucca Mountain during FY 1991. These activities include seismic, hydrologic, and meteorologic monitoring, studies of volcanic processes and events, laboratory work such as geochemical and rock mechanics studies, prototype testing as conducted at Apache Leap, Arizona, quality assurance activities, and program management. Once the necessary permits are obtained, the scientific investigation activities that have been delayed by the lack of permits can proceed at the required pace.

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BIOGRAPHY

WILLIAM H. YOUNG

William H. Young was nominated to be Assistant Secretary for Nuclear Energy, U.S. Department of Energy (DOE) on September 29, 1989, and was confirmed by the Senate on November 9, 1989. In this capacity, Mr. Young serves as the principal policy advisor to the Secretary of Energy on nuclear energy.

Mr. Young manages an organization responsible for operation of DOE test and research reactors; advanced civilian reactor development and design; advanced space and defense nuclear isotope and power systems; the U.S. uranium enrichment enterprise; and the Naval nuclear propulsion program. The organization also develops, interprets and coordinates nuclear safety policy for all DOE reactors and nuclear facilities.

Mr. Young has more than 30 years of broad experience in the nuclear energy field. He formed William H. Young & Associates, Inc., in 1985 to do management consulting and part-time writing. He directed corporate performance and cost evaluations of electric utility companies and nuclear power plants, working largely in association with Pickard, Lowe and Garrick, Inc.

From 1971 to 1985, Mr. Young was employed by Burns & Roe, Inc. During 1984 and 1985, he was Vice President, Project Operations, in charge of nuclear and fossil power plant projects, both domestic and international. He was also a Director of the corporation. From 1976 to 1983, he served as Vice President, Breeder Reactor Division, responsible for all breeder reactor design and development activities of the corporation. He also headed corporate strategic planning for five years, reporting to the Board of Directors.

Between 1962 and 1971, Mr. Young held various positions in the U.S. Atomic Energy Commission (AEC), Division of Naval Reactors. He was Associate Director for Submarines from 1968 to 1971, responsible for direction of engineering, construction and testing of nuclear reactor plants for a 37-ship class of submarines built in five shipyards. From 1966 to 1968, he was head of the AEC Office responsible for oversight of reactor safety and all other nuclear activities at the Electric Boat shipyard.

Mr. Young earned a B.S. in Naval Architecture and Marine Engineering from Webb Institute of Naval Architecture and an M.S. in Engineering from The George Washington University. He completed a six-month course at the Bettis School of Reactor Technology, roughly equivalent to an M.S. in nuclear engineering, while an officer in the U.S. Navy. He studied business administration at the graduate level.

(more)

Mr. Young is a Registered Professional Nuclear Engineer in the State of California, and is a member of the American Nuclear Society, the American Management Association and the Society of Naval Architects and Marine Engineers. He is a former member of the American Society of Mechanical Engineers and former Chairman, Advanced Reactors Subcommittee, Nuclear Engineering Committee.

Mr. Young was born and raised in Ilion, New York, where his mother, Marie Young, still resides. He graduated from Ilion High School in 1952.

Mr. Young is married and has three grown children, Deborah Streeton, William and Elizabeth. He and his wife, Betty, currently reside in Wyckoff, New Jersey.

February 1990

STATEMENT OF WILLIAM H. YOUNG

ASSISTANT SECRETARY FOR NUCLEAR ENERGY

BEFORE THE

HOUSE APPROPRIATIONS COMMITTEE

SUBCOMMITTEE ON ENERGY

AND WATER DEVELOPMENT

MARCH 8, 1990

Mr. Chairman, I am pleased to have this opportunity to discuss the Department of Energy's (DOE's) programs and fiscal year 1991 budget request for its Nuclear Energy Supply Research and Development and Uranium Enrichment activities.

The requested funds are distributed among program elements summarized in the following tables.

Budget Authority
($ in Millions)

Program Element	FY 1990 Appropriation	FY 1991 Request
Energy Supply R&D		
Nuclear Energy R&D	341.9	357.8
Policy and Management	5.1*	32.9
Total	347.0	390.7
Uranium Supply & Enrichment Activities		
Uranium Enrichment Activities	1412.4	1480.5
Revenues to Offset B/A	-1417.2	-1480.5
Isotope Production and Distribution Fund		
Isotope Production and Distribution	16.0	16.2
Revenues	-16.0	-16.2
Net Isotope Production and Distribution	0	0

Budget Outlays
($ in Millions)

Program Element	FY 1990 Appropriation	FY 1991 Request
Energy Supply R&D		
Nuclear Energy R&D	341.8	357.8
Policy and Management	5.1*	32.9
Total	346.9	390.7

*Includes comparability adjustment for Nuclear Facility Safety Advisory Committee of an additional $3.0 in FY 1990.

Uranium Supply & Enrichment Activities	FY 1990 Appropriation	FY 1991 Request
Uranium Enrichment Activities	1412.4	1480.5
Revenues to Offset B/O	-1417.2	-1480.5
Revenues to D&D Fund	0	-50.0
Isotope Production & Distribution Fund		
Isotope Production and Distribution	16.0	16.2
Revenues	-16.0	-16.2
Net Isotope Production and Distribution	0	0

OVERVIEW

At the President's direction, the Secretary of Energy has initiated the development of a National Energy Strategy (NES). The strategy is designed to provide direction for the Department's future policy and funding initiatives. It will provide a comprehensive, long-range strategy for addressing the Nation's near, mid-and long-term energy needs. The strategy will be based on public input through hearings, written submissions and publicly available reports, all aimed at reconciling our need for secure, competitively priced supplies of energy with environmental, safety and health requirements. An interim report based on the findings from the public hearings will be presented to the President in April 1990. Following this report, the Department will conduct additional hearings to identify the appropriate options to recommend to the President in our final report in December.

Nuclear power can play an important role in maintaining a balanced and secure energy supply for the United State's domestic electrical power, space and military needs. In 1989, nuclear power provided almost twenty

percent of the Nation's electricity. Nuclear energy also was the power source that helped make possible the Voyager II and Galileo missions.

Although the NES is not yet complete, the FY 1991 budget reflects the ongoing commitment of the Department to nuclear power. The key to restoring public confidence in nuclear power is a sustained, positive track record of operational safety. I am pledged to ensuring the safe operation of the nuclear facilities under my supervision at the Department of Energy. It is my goal to develop within the Office of Nuclear Energy a culture that encourages and rewards excellence and safety in operations.

For commericial nuclear plants, the current antiquated, cumbersome nuclear regulatory process must be made more stable and predictable. Reform of the process will enhance safety, provide confidence in cost and construction schedules, and allow a reasoned judgment on the benefits of nuclear-generated electricity. The Nuclear Regulatory Commission (NRC) has made important progress in this area with the issuance of the recent licensing reform rule.

We will continue to act in concert with the industry and the NRC regarding the development and certification of advanced standardized reactor designs. The advanced standard reactor development programs focus on standardized designs which simplify current designs and incorporate additional or passive features to enhance safety, provide greater reliability and lower costs. The Department will continue to work closely with the industry and the NRC to ensure that standardization of reactor designs becomes a reality perhaps as early as 1991, thus enabling rapid licensing and deployment of nuclear units.

In the short-term, the most promising advanced reactor technology is the Advanced Light Water Reactor. The Department and industry have a cooperative program, on a 50-50 cost-sharing basis, for design development and certification of passively safe, mid-sized Advanced Light Water Reactors. The Department of Energy believes that this design has significant potential for revitalizing the nuclear option. It is expected that the development of the passive mid-sized Advanced Light Water Reactor will result in the availability of certified plant designs in 1995.

Advanced reactor systems offer the potential for significant improvements in safety, economics, licensibility, and waste management. The technologies we are developing feature modular, factory-fabricated, standardized designs which enable simplified licensing, lower construction costs, improved quality assurance and greater flexibility for utilities to meet load growth.

The Modular High Temperature Gas Reactor (MHTGR) offers a unique containment approach featuring high temperature coated fuel particles providing a redundant and diverse barrier to the release of fission products under all conditions. The heat removal system is completely passive and remains within the final containment barrier. Perhaps equally important, the MHTGR is the only reactor option for high temperature process applications. Because of its passive features, this design has garnered considerable support as a next generation powerplant.

As we approach the 21st century, Advanced Liquid Metal Reactor (LMR) research and development will be complete and the design will be ready for use. This reactor has the unique ability to "burn" the longest-lived nuclear waste, including recycled waste from light water reactors, thereby simplifying waste management and disposal. We believe that development of

this technology would reduce the highly radioactive life of stored waste from hundreds of thousands of years to hundreds of years.

This reactor design provides for the on-site location of the fuel recycle facility, where spent fuel is processed by chemical means, reclad, and recycled into the reactor again. The LMR is also unique in that it is the only reactor technology that can extend uranium resources if operated as a breeder reactor.

This Administration believes that the uranium enrichment enterprise should be transferred to the private sector, through the intermediate step of the establishment of a Government-owned corporation. A restructured uranium enrichment enterprise could compete more effectively with foreign suppliers, generate a greater return to the government for its past investment in the program, provide for more cost effective operations that continue to support the energy security of the United States, and enhance this country's balance of payments. Efforts will continue apace to ensure the near full-scale demonstration of the Atomic Vapor Laser Isotope Separation (AVLIS) technology by the end of calendar year 1992. AVLIS is the world's most advanced enrichment technology and the United States enjoys a substantial lead in its development. Since the AVLIS technology is projected to be able to enrich uranium at half the cost of any other enrichment technology, the successful commericial application of AVLIS can generate a significant competitive advantage in the market with a large return.

In addition to civilian nuclear power, the Office of Nuclear Energy is supporting the space and defense power systems program. We have solidified the commitment of DOE, DOD, and NASA to develop the SP-100 space reactor power system through an amendment signed last October to the existing

SP-100 Memorandum of Agreement. This space nuclear technology will provide power to the user community in the tens to hundreds of kilowatts electric range. We look for significant progress to continue in the SP- 100 development program in FY 1991. Also, we will continue RTG development and production for NASA's CRAF and Cassini missions scheduled for launch in 1995 and 1996. These same RTGs were responsible for the incredible photographs of Neptune which the Voyager spacecraft sent back last August.

The Office of Nuclear Energy is committed to operating the isotope production and distribution program on a business footing. This program provides radioactive and stable isotope products and associated services to domestic and international markets. These materials and services are produced, processed and provided through the utilization of DOE facilities, and their ultimate applications include medical research and health care, industrial research and manufacturing, agriculture, food preservation, education, and national defense.

The budget also reflects the Department's decision, subject to Congressional approval, to initiate the shutdown of a major NE test facility -- the Fast Flux Test Facility (FFTF) at Hanford -- and to produce Pu-238 for use in radioisotope power supplies at the Savannah River Site (SRS). The main reasons for this decision are cost and schedule advantages for producing Pu-238 at SRS and lack of other long-term missions for FFTF, which costs about $115 million per year to operate. The FFTF shutdown should begin in April 1990, pending Congressional review. The permanent shutdown will take four or five years.

The Department is disappointed that the House Appropriations Committee has not agreed with request to reprogram funds to initiate shutdown of the FFTF. We continue to believe that our proposal to initiate this shutdown

is the correct one. We reached this decision after full evaluation of the current and potential uses of this facility and the costs of its operation, from which we concluded that the remaining and potential work can no longer justify the expense of operating the FFTF.

I would now like to address the Office of Nuclear Energy's FY 1991 budget request in greater detail.

NUCLEAR ENERGY RESEARCH AND DEVELOPMENT

The funding request for Nuclear Energy R&D programs is contained in the following table.

Budget Authority
($ in Millions)

Program Element	FY 1990 Appropriation	FY 1991 Request
Nuclear Energy R&D		
Light Water Reactors	24.4	31.5
Advanced Reactor R&D	58.8	47.0
Facilities	169.6	140.5
Space Reactor Power Systems	31.3	54.5
Advanced Radioisotope Power Systems	49.0	75.5
Program Direction	8.7	8.8
Total	341.8	357.8

LIGHT WATER REACTORS

The Light Reactor (LWR) program provides a melding of an extensive worldwide operational experience base with the opportunity to incorporate major improvements, such as the use of passive safety features, modular construction, and simplifications to improved Advanced Light Water Reactors (ALWR's) that can be developed and deployed without the need for a demonstration plant.

The objectives of DOE's LWR program are to cooperate with the industry to:

- o assist in the removal of institutional and regulatory obstacles that are preventing nuclear power projects from competing freely in the marketplace;

- o support technology efforts to revitalize the LWR option for the United States and to ensure its long-term availability as a vital component of the national energy supply system; and

- o ensure that the national resource of more than 100 operating LWRs is not prematurely lost due to arbitrary licensing periods.

The FY 1991 budget request of $31.5 million will enable the Office of Nuclear Energy to perform the following primary functions:

First, the Office of Nuclear Energy supports a future plant life extension program which will help ensure that the national resource of more than 100 reactors currently operating is not prematurely lost due to the expiration of an arbitrary licensing period. The nuclear units now operating are a large untapped resource of future energy when one considers that their current license life of 40 years is not based on technical considerations. An additional 20 years of operating life, representing nearly 98 gigawatts of capacity, is potentially available and can directly offset some of the need for new or replacement generating units. In order to preserve this resource, the criteria and technical bases for replacement, refurbishment, and continued use of components and systems, as well as the procedural requirements to be used by regulators for license extension reviews, must be developed and agreed upon.

The Office of Nuclear Energy is co-funding a plant life extension demonstration program with the utilities. In 1991, we expect lead license renewal applications to be submitted to the NRC to extend the lives of the Yankee Rowe and Monticello nuclear plants by 20 years. The initial efforts in FY 1990 on these two lead plants was on system level age-related degradation evaluations to identify specific equipment needing additional technical justification for license renewal. The focus is on completing all equipment evaluations to support application submittal in 1991. In addition, environmental analysis to support the application will be initiated in FY 1990. We hope to obtain approval of these renewals from the NRC by 1993.

Second, we have a cost-sharing program with industry to demonstrate the viability of the nuclear plant standardization and licensing process by obtaining NRC certification in 1991 of one or more Advanced Light Water Reactor (ALWR) designs of 1,250-1,350 MWe. Reactors being reviewed by NRC include the General Electric Advanced Boiling Water Reactor (ABWR) design, developed in collaboration with the Japanese, and the Combustion Engineering System 80+ Advanced Pressurized Water Reactor design, that is based on the Palo Verde station system 80+ design modernization and modified to comply with the ALWR Utility Requirements Document for evolutionary plants.

The ABWR incorporates the best technology available worldwide, such as the use of internal recirculation pumps, to increase design margins, reduce severe accident probabilities and simplify design. During the past year, GE completed the submittal of the entire ABWR Standard Safety Analysis Report (SSAR) to the NRC, and the NRC review is in progress. ABWR Final

Design Approval is expected about December 1990, with Design Certification in September 1991.

For the CE System 80+ design, a major part of the SSAR has been submitted to the NRC covering the Nuclear Island portion of the plant and the Balance-of-Plant interfaces. However, to comply with the latest 10 C.F.R. 52 regulations regarding certification, the submittal to the NRC must be amplified to cover the full plant. We are working with Combustion Engineering to determine means by which this program can be completed.

Third, we are supporting a program to develop and certify by 1995 (in a cost sharing arrangement with industry) simplified mid-size (600 MWe) advanced light water reactors employing passive safety features and modular construction. These plants offer the opportunity to incorporate further, highly desirable changes to the LWRs. Designs are being developed which will not only build on the extensive experience base from the three decades of light water reactor operations, but also will take advantage of potential simplifications and innovations in design and construction that are unique to the smaller power rating. These include the application of more passive systems, such as gravity or natural circulation, to remove decay heat and provide emergency core cooling to prevent core damage, as well as the increased use of modularization to reduce construction time.

We have confirmed the technical and economic feasibility of this type of plant and have selected the Westinghouse AP600 and General Electric SBWR designs for further development and certification. In 1990 and 1991, Westinghouse and General Electric will conduct detailed design and development, and prepare licensing documentation to permit NRC Design Certification of these plants by mid-1995. Safety Analysis Reports will be submitted to the NRC in 1992, with Final Design Approvals targeted for

1994. This program is being carried out in coordination with the Electric Power Research Institute/Utility ALWR Program.

The Advanced Reactor Severe Accident Program (ARSAP) is applying the methods and technology developed from DOE's and NRC's severe accident programs to the ALWR certifications and to the development of the ALWR Requirements Document. The key chapter on safety and severe accidents in the document has been submitted to NRC and interactions are ongoing. The NRC Safety Evaluation Report on this chapter is anticipated in spring 1990. The program is also supporting ALWR certification program by providing recommendations for closing severe accident issues for the ALWR and is providing updated tools for severe accident evaluations.

Fourth, we plan to demonstrate the early site approval licensing process, through a cost-sharing arrangement with the private sector, by obtaining an NRC Early Site Permit by 1995. This activity will complement the design certification demonstration and will be a major step in providing confidence that regulatory obstacles to new plant orders are being addressed. This demonstration will address key issues raised by the new NRC licensing process, including the emergency planning question. During 1990, a process to select an industry co-sponsor of this activity will be initiated. Work will start in 1991 with issuance of the Early Site Permit targeted for 1995.

THREE MILE ISLAND

No additional funding for Three Mile Island (TMI) activities is being requested in FY 1991 because DOE will complete its research and development program with funds appropriated for FY 1988.

The GPU Nuclear Corporation (GPU Nuclear) expects to complete defueling of the core debris in March 1990 with completion of debris shipments in April 1990. GPU Nuclear also expects to complete the recovery program and place the plant in a safe, monitored condition during 1990.

During FY 1989, work continued on completing the final reports in the TMI-2 accident evaluation program. A revised accident scenario report was prepared, and will be further modified in FY 1990 to incorporate final results from the NRC-sponsored examination of lower vessel debris samples. Other final reports scheduled for completion in FY 1990 include: the core bore examination report, the fission product report, and the Committee on Safety of Nuclear Installations (CSNI) standard problem report.

NUCLEAR SAFETY

In FY 1991, the Office of Nuclear Energy will continue its emphasis on assurance of nuclear safety in accordance with the initiatives of the Secretary. Nuclear safety activities are funded under the Policy and Management account in the budget. In FY 1991, $27.6 million will be expended to perform the nuclear safety policy and self assessment functions described below.

NUCLEAR SAFETY POLICY

The Office of Nuclear Energy has been assigned responsibility for developing and coordinating Department policy for nuclear reactors and non-reactor nuclear facility safety. This responsibility entails 1) the development, coordination, and interpretation of nuclear safety policy for all Department of Energy nuclear reactors and non-reactor nuclear facilities and 2) the establishment, issuance, and maintenance of nuclear

standards to implement such policy. Reactor and non-reactor nuclear facility safety encompasses all systems and activities that can influence the release of fission products, or nuclear criticality. The assurance of nuclear safety involves not only verification that nuclear reactor and non-reactor nuclear facility designs comply with applicable standards, but that plant modifications, operations, maintenance, and plant material conditions meet nuclear safety requirements and that appropriate attention is given to human performance aspects potentially affecting nuclear safety.

During FY 1991 a major effort will be the development and modernization of nuclear safety standards. This continues the effort initiated in response to the recommendations of the National Academy of Sciences. The process of identifying and correcting nuclear safety policy gaps, inadequacies in existing standards, and reviewing NRC regulations and commercial standards for applicability to DOE facilities will be continued.

The development and implementation of training programs for facility operators and a training accreditation program to promote and assure a high level of technical competence are important components of the proposed activities. Training will also be vital for the effective implementation of a new unusual occurrence reporting system that is designed to capture off normal events and then to assure that corrective actions are taken to preclude the recurrence of these and similar type events.

NUCLEAR SAFETY SELF-ASSESSMENT

A nuclear safety self-assessment function is being formed to perform independent design, construction, and operational evaluations of facilities operated for the Office of Nuclear Energy. This activity will separately check, on a sample basis, the nuclear safety performance being achieved by

line management. For example, Safety Analysis Reports and supporting documentation will be audited on a sample basis, the technical bases of technical specifications and operational safety requirements will be reviewed; and the effectiveness of line managers conduct of Technical Safety Appraisals and functional appraisals, and management reviews, will be audited. In addition, independent investigations of the effectiveness and compliance with policy for unusual occurrence investigations and other on-site diagnostic evaluations will be conducted to evaluate nuclear safety performance.

This activity will also trend operating data and monitor safety through a performance indicator program. It will evaluate trends and patterns at nuclear facilities of the Office of Nuclear Energy. Comprehensive reviews will be conducted during FY 1991 on all Nuclear Energy Class A reactors and those Class A reactors Nuclear Energy has recently been assigned from the Office of Energy Research.

An important component of the nuclear safety self-assessment function is the establishment of nuclear quality assurance requirements for Nuclear Energy programs. Assessments will be performed of Nuclear Energy program facilities and operations to obtain independent verification of the status of nuclear quality assurance programs and their compliance with applicable policies and standards.

ADVANCED REACTOR R&D

For FY 1991, the Department is requesting $47.0 million for advanced reactor research and development and $140.5 million for support of nuclear energy facilities. The Department's program is centered around the modular high temperature gas reactor (MHTGR) and the advanced liquid metal reactor (LMR) with its associated metal fuel cycle. These advanced reactor systems

offer the potential for significant improvements in safety through the use of systems that depend on the physical laws and properties of materials rather than engineered safety systems.

- Among the passive safety features of the MHTGR is the unique capability for safe shutdown, without radioactive release, in a loss of coolant event. It remains the only option for high temperature process heat applications.

- The advanced LMR has the unique ability to utilize as fuel the actinides from nuclear waste, including recycled waste from LWRs. By burning the actinide elements that dominate the long term hazards of spent reactor fuel, some issues relating to the current waste management strategies could be significantly simplified. In addition, the LMR has the capability to withstand severe upset conditions without danger, and is the only reactor option that can greatly extend uranium resources.

The advanced reactor systems being developed feature modular, factory-fabricated, standardized designs that provide for shorter construction schedules and lower construction costs, improve quality assurance, and give greater flexibility for utilities to meet load growth. Joint U.S. and foreign funding of R&D minimizes advanced reactor program and nuclear energy facilities costs and supports completion of required R&D.

MODULAR HIGH TEMPERATURE GAS REACTOR

The FY 1991 advanced reactor R&D budget request includes $25.0 million for the MHTGR program. The following activities will be emphasized in FY 1991:

multi-module controls; passive reactor cavity cooling systems; fuel fabrication; component development; irradiation testing; and licensing interactions with the NRC. International cooperative R&D efforts will continue under existing agreements with Japan, Germany, France, Switzerland and the United Kingdom. For FY 1991, resolution of the issues identified by the NRC in its review of the Safety Evaluation Report will be completed. Preliminary briefings on the Preliminary Standard Safety Analysis Report (PSAR) with the NRC and others will be initiated. The first series of fuel irradiation and transport tests in the COMEDIE loop in France will be completed.

Additional funding provided by private sector/foreign sources as part of a cost sharing initiative would be used to further emphasize preliminary design and licensing activities in support of current plans for submittal of a PSAR to the NRC in FY 1992.

The MHTGR is one of the reactor technologies being assessed for New Production Reactor (NPR) development. A plan to coordinate and integrate civilian and defense R&D programs has been developed. About $29 million of NPR funding in FY 1991 has been identified for activities that are also in need of development for the civilian MHTGR technology development plan. These areas of commonality include the fabrication of fuel, validation of fuel performance and fission product behavior, materials development, and validation of the reliability of key components and system performance.

ADVANCED LIQUID METAL REACTOR

The FY 1991 advanced reactor R&D budget request includes $22.0 million for liquid metal reactor program activities. Key activities are to: experimentally demonstrate the Integral Fast Reactor (IFR) concept; to

continue the design and licensing activities; and to test major components and key features in Nuclear Energy test facilities.

During FY 1991, IFR program efforts at Argonne National Laboratory (ANL) will continue to confirm the passive safety and improved economic potential of small sodium-cooled reactors using metallic fuel and pyrometallurgical fuel reprocessing. International support has been developed to supplement the Department's funding of the IFR program. During FY 1990 hot operations of the Hot Fuel Examination Facility-South at ANL-West, in Idaho, for the IFR fuel recycle demonstration are planned.

Efforts will be initiated to evaluate the capability of the LMR to recycle spent fuel and convert the long-lived actinide elements (plutonium, neptunium, and others) present in spent LWR, LMR, and MHTGR fuel. Actinide conversion in an LMR has the potential to reduce the amount of toxic material destined for permanent underground storage and reduce the biological hazard of high-level waste from hundreds of thousands of years to hundreds of years.

General Electric is the prime contractor for the reference LMR plant design and licensing. A three-year contract for advanced conceptual design with an optional two-year preliminary design phase was signed in January 1989 for the development of the concept. Because of the current and anticipated funding constraints, the FY 91 request for this activity provides a minimal level of funding to enable design efforts to focus on the utilization of the integrated metal fuel cycle and actinide recycle activities. Interactions with NRC will continue and the results of ongoing reviews will be used to update design features and to resolve key issues identified by the NRC in the draft Safety Evaluation Report issued in October 1989.

Facilities testing of major components and key features will focus on establishing the performance characteristics of advanced fuels and materials and the self-cooled electromagnetic pump. Such testing provides the technical basis for major regulatory reform through demonstration of passive safety features and performance capability.

International cooperative efforts will continue in FY 1991 in the area of the LMR oxide fuel cycle. Active agreements are in place with the Power Reactor and Nuclear Fuel Development Corporation (PNC) of Japan and the United Kingdom Atomic Energy Authority (UKAEA) covering separations and technology and with the Commissariate a l'Energie Atomique (CEA) of France in the area of remote systems technology. In this country, research and development is carried out under the Consolidated Fuel Reprocessing Program (CFRP) at the Oak Ridge National Laboratory (ORNL). Shielding experiments and the collection of reliability and failure data from existing domestic and foreign LMRs will continue with international support.

FACILITIES

Nuclear Energy facilities provide safe and reliable testing capabilities essential to develop and verify nuclear power technology and systems for space and defense, civilian reactor development, fusion, international, and other DOE programs. The key facilities funded by the Nuclear Energy R&D Facilities Appropriation include the Experimental Breeder Reactor-II (EBR-II), the Fuel Manufacturing Facility (FMF), the Transient Reactor Test Facility (TREAT), the Zero Power Physics Reactor (ZPPR), and the Hot Fuel Examination Facility (HFEF), all at the Argonne National Laboratory-West (ANL-W) near Idaho Falls, Idaho; the Fast Flux Test Facility (FFTF) and the Fuels and Materials Examination Facility (FMEF) at the Westinghouse Hanford Company (WHC), near Richland, Washington; and the comprehensive non-nuclear

component test complex at the Energy Technology Engineering Center (ETEC) near Canoga Park, California.

Over the years, Nuclear Energy's facilities have compiled an outstanding record, both in safety and environmental compliance, while successfully fulfilling our test missions. Nevertheless, consistent with the Department's current policy, we are in the process of strengthening our management and otherwise enhancing our efforts to assure the continued safe, environmentally acceptable, and reliable operation of our facilities. These efforts will build upon the improvements in management and operations which have already been made in response to the reviews of the National Academy of Sciences and the Department's Advisory Committee for Nuclear Facility Safety and fully implement applicable Institute of Nuclear Power Operations good practices. Examples of such major action are: (1) probablistic risk assessments are being conducted to provide insight to safety analyses and to serve as an additional tool in the reactor safety decision-making process; (2) studies are being conducted to assess reactor operational lifetimes; (3) procedures have been put in place at our operating facilities to ensure that INPO appropriate good practies are applied to our facilities; and, (4) increased emphasis is being placed on ensuring that required equipment upgrades are made in time to allow continued reliable, safe operation.

We have also improved the cost-effectiveness of Nuclear Energy's facilities by improving the efficiency of our operating facilities and by closing out of non-essential operations. For example, the privately-financed electric generation system constructed at ETEC which began operation in 1988, now produces revenues from the sale of electricity during the conduct of

advanced steam generator performance and endurance testing. In addition, the Zero Power Plutonium Reactor has been placed in a standby mode.

ANL-W is the technology center for the IFR program including metal fuel processing, fabrication, and waste treatment demonstrations to verify the closed metal fuel cycle. In FY 1991, continued emphasis is on completing HFEF-South modifications and starting facility checkout operations for metal fuel refabrication, reprocessing and waste treatment; on EBR-II passive safety testing; on fabricating advanced metal driver and experimental fuel for EBR-II, on performance of binary and ternary metal fuels in EBR-II, and on safety testing in TREAT. Activities planned for FY 1991 include initiation of metal fuel fabrication, reprocessing and waste treatment operations in the metal fuel processing systems in the HFEF-South, continued performance assessment of binary and ternary metal fuels in EBR-II, safety testing in TREAT, and continued advanced reactor safety testing in EBR-II.

In analyzing the significant alternate use of the FFTF for plutonium-238 production, it was determined that PU-238 can be produced less expensively, and in the only manner that meets schedule requirements for use of this material in radioisotope power suppliers, at our facilities in Savannah River, South Carolina. Capital costs in excess of $100 million would be needed to provide PU-238 processing and encapsulation facilities at Hanford. In addition, the $110-115 million annual operating costs for the FFTF, for the most part, would have to be borne by the Pu-238 mission, due to the absence of other major program funding at the facility. The conclusion of the comprehensive evaluation of long-term missions of FFTF at Hanford is that the amount of work at FFTF under the Advanced Reactor Program, the primary user of the facility, and under secondary users, does

not justify the expense of its operation. The orderly shutdown of FFTF to an industrially and radiologically safe condition is scheduled for FY 1990, subject to congressional approval.

Also located at Hanford is the FMEF. Current plans call for portions of the FMEF to be utilized to assemble and test completed radioisotope thermoelectric generators (Radioisotope Power Systems Facility). Design, safety, and environmental activities for this effort are currently underway.

ETEC focuses on non-nuclear testing of liquid metal components with emphasis on steam generator performance and endurance testing at the Sodium Component Test Installation. Performance testing of the Helical Coil Steam Generator has been concluded. We are now directing our efforts to design and facility preparation activities to prepare for testing of the Double Wall Tube Steam Generator under a cooperative U.S.-Japan agreement. Testing is planned to begin in FY 1991 and be completed in FY 1993.

Other testing and component and systems development activities are being conducted at ETEC in support of other DOE programs and private industry. In fact, more than one-half of the funding for operations is currently being derived from sources outside the Nuclear Energy R&D budget (including revenues from private utilities for electrical generation on the ETEC site). The New Production Reactor program is also considering utilization of the ETEC for system and component testing and other development activities.

Other facility activities include operation of the Tower Shielding Facility at Oak Ridge to support the cooperative U.S./Japan shielding development

programs. Studies, evaluations, and management support activities will be continued as needed.

ADVANCED RADIATION TECHNOLOGY PROGRAM

In FY 1986, Congress directed DOE to initiate a civilian byproducts utilization activity to demonstrate commercial viability in the application of advanced radiation technology in the treatment of food. In FY 1990, DOE signed cooperative agreements with all designated organizations for development of commodity irradiation projects in Florida, Iowa, Hawaii, Washington, Alaska, and Oklahoma.

Since no FY 1989 funding was received to continue the food irradiation projects, and the Department requested no FY 1990 or FY 1991 funding for this activity, two projects (Iowa and Florida) are being continued with prior year funds. The construction of the facility in Florida will be initiated upon final approval of the environmental assessment. Delivery of the irradiation accelerator is scheduled for June 1990. At Iowa, facility design is in its final stages, and the irradiation accelerator is scheduled for delivery in late FY 1990.

ISOTOPES PRODUCTION AND DISTRIBUTION

Since 1946, the Department of Energy (DOE) and its predecessor agencies have been the primary supplier of a large number of isotopes, produced in a number of DOE facilities, for domestic and foreign users in a variety of medical, industrial, agricultural, research, and other applications. The management responsibility for the production and distribution of isotopes was assigned to the Office of Nuclear Energy where the Office of Isotope Production and Distribution was established and assigned the overall

responsibility for the development of policies, objectives, and general management of the program. Beginning October 1, 1989, Congress approved the Department's request to establish a single fund in which the cost and revenues associated with the production and sales of isotopes would be reflected.

In Fiscal Year 1991, the Isotope Production and Distribution Program will continue to provide radioactive and stable isotope products and associated services to a wide and varied domestic and international market. We anticipate that the production and operating expenses associated with this program will amount to $16.2 million dollars, which will be offset by receipts from the sales of these isotopes and related services amounting also to $16.2 million. This program is essentially a business, and we think it should be conducted as one. Therefore, beginning in FY 1990, we have established a revolving fund that will provide for the incremental costs associated with the production, sale, and distribution of all DOE-supplied isotopes. This fund will permit the program to retain revenues generated by the fund, which will then be used to continue ongoing operations and provide for other incremental costs associated with the program. The effect of these efforts will be to assure through clearly delineated management channels and budget controls, the continuation of the benefits gained from the use of nuclear isotopes.

SPACE REACTOR POWER SYSTEMS

The Space Reactor Power Systems program remains a vitally important element of the Department's Nuclear Energy R&D effort. The program's primary mission is to develop nuclear energy power supply systems to respond to requirements identified by user agencies, such as the National Aeronautics

and Space Administration (NASA) and the Department of Defense (DOD). Program activities over the years have included the design, development, fabrication and testing of compact, high performance reactors for space and terrestrial applications. In general, these power systems and the technologies developed in this program are intended to operate in remote and demanding environments, independent from logistical supply chains. In many cases, they represent the only power sources capable of fully meeting user mission requirements. Currently, the emphasis is on space power systems. The program is comprised of two main projects - the SP-100 space reactor in the range of tens to hundreds of kilowatts-electric; and the Multimegawatt (MMW)/Special Power Systems program, which encompasses the Thermionic Fuel Element Verification program and Special Power Systems.

The Department has undertaken these nuclear energy projects to meet expanding space and defense power requirements as part of its overall nuclear development charter under the Atomic Energy Act to support other Federal agencies as well as civilian energy needs. In addition to the funding provided by DOE, these projects are also supported by NASA and/or DOD.

The Fy 1991 funding request for DOE's Space Reactor Power Systems program is $54.5 million an increase of $23.2 million over FY 1990. This increase allows the Department to fulfill its funding commitment for the SP-100 program reflected to in the amended triagency Memorandum of Agreement with NASA and DOD.

SP-100 SPACE REACTOR

The objective of the SP-100 project is to develop, demonstrate, and make available to the user community space nuclear reactor technology in the

tens to hundreds of kilowatts-electric range. The SP-100 is in the fifth year of engineering and design of its ground test reactor, with nuclear fuel, materials and component tests underway.

A major restructuring of the program has occurred due to fiscal constraints over the past several years. Presently, the SP-100 program is pursuing reactor and converter efforts, delaying other nonnuclear activities of the program. This development path was informally accepted by all the participating agencies. However, a Program Review Group was established with senior members from the sponsoring agencies to review all aspects of the SP-100 Program. This Group's findings are scheduled to be reported to the SP-100 Steering Committee in March 1990. Their recommendations are anticipated to strengthen the program by ensuring proper activities are emphasized to meet the space power needs of the future.

The SP-100 user agencies, NASA and DOD, have recently shown a strong recommitment to the SP-100 program. In October 1989, a formal amendment to the existing SP-100 Memorandum of Agreement was signed, which included projected funding levels by agency by year through FY 1994.

In FY 1990, a thermoelectric cell using a number of advanced technologies was tested which produced approximately 5 watts of power from a cell approximately one inch square. In 1991, a fully prototypic thermoelectric cell, qualified at high temperatures, will be placed on test. Successful testing of this cell will lead to fabrication of a thermoelectric array, the configuration in which the thermoelectric cells will be used in flight.

The SP-100 program has made the transition from a program of primarily design and analyses to a hardware program of fabrication and test. In FY 1991, a full scale hydraulic flow test of the nuclear assembly will take

place at GE and major procurements in support of the nuclear assembly test, including the vacuum chamber and refractory materials, will take place.

MULTIMEGAWATT/SPECIAL POWER SYSTEMS

The Thermionic Fuel Element (TFE) Verification program is the primary effort within the MMW/Special Power Systems program. This effort was established to resolve outstanding issues associated with the use of thermionic fuel elements in continuous space reactor systems so thermionics could be a viable technology choice for future space reactor systems.

The development effort includes primarily a series of tests in irradiation facilities involving insulators, fueled emitters, collectors, and single cell thermionic converters. The program will continue component testing initiated in recent years and culminate in FY 1993 with a prototypical test of a thermionic fuel element in a fast reactor environment.

The Special Power Systems program was established to conduct nuclear reactor system assessments and associated technology development activities necessary to support advanced space or terrestrial reactor applications. Technology efforts may include improved fuels development and advanced material fabrication techniques.

The MMW Space Reactor program, which has been a Strategic Defense Initiative Organization (SDIO) funded program managed by DOE, recently completed Phase I by conducting a formal concept evaluation, selecting three of the six Phase I concepts for Phase II. Subsequently, the SDIO announced that due to funding reductions, this program may not be funded in FY 1990. No DOE funds were appropriated in FY 1990, nor have any been requested for FY 1991. However, since NASA recently identified nuclear propulsion and nuclear surface power as critical technology needs for

supporting the President's initiative for the human exploration of the Moon and Mars, options for continuing the MMW program will be examined until a decision is made whether to proceed with this program in support of the Moon/Mars mission.

ADVANCED RADIOISOTOPE POWER SYSTEMS

The purpose of the Advanced Radioisotope Power Systems program is to produce radioisotope power sources for U.S. civilian and military space and terrestrial missions. Radioisotope power sources have been in use for almost three decades and are the cornerstone of the Nation's space nuclear power program where proven, reliable and maintenance free power supplies capable of producing up to a kilowatt of electricity for tens of years is required. Radioisotope power supplies recently enabled the Voyager spacecraft to return data on the planet Neptune and are powering the Galileo spacecraft now on its voyage to Jupiter.

The Advanced Radioisotope Power System program provides base support for radioisotope fuel and heat source development, production and qualification; nuclear safety analysis and testing; power converter system development; and all aspects of manufacturing, quality assurance, reliability, and operational safety for radioisotope power systems. The program includes construction of the Radioisotope Power Systems Facility (RPSF) at Hanford, Washington, in which future radioisotope power systems will be assembled and tested in a modern facility meeting all safety and environmental requirements. The RPSF will replace an older facility at the Mound Laboratory in Miamisburg, Ohio.

Current radioisotope power projects include NASA's Ulysses, Comet Rendezvous Asteroid Flyby (CRAF), and Cassini missions as well as DOD's

special terrestrial applications. These projects are jointly funded with DOD or NASA. The funding request for these activities increases from $49.0 million in FY 1990 to $75.5 million in FY 1991. This increase reflects support for two new FY 1990 NASA programs -- the Comet Rendezvous Asteroid Flyby (CRAF) and Cassini missions, the essential completion of the Radioisotope Power System Facility, and restoration of facilities to resume production operations.

RADIOISOTOPE THERMOELECTRIC GENERATORS

In FY 1990 and 1991, DOE intends to commit resources to the production of Plutonium-238 fuel and initiate manufacturing operations of iridium heat source components and carbon insulator assemblies for fabrication of radioisotope thermoelectric generator (RTG) fuel capsules and heat source modules for the CRAF and Cassini missions. In FY 1990, the selection process will be completed and an award made for a systems contractor for the CRAF and Cassini flight programs. In FY 1991, the Preliminary Safety Analysis Report for these new missions will be completed and the Safety Test Program initiated to support NASA's CRAF and Cassini schedules. The Systems Contractor will initiate the layout and qualification of the manufacturing line to procure the thermoelectric unicouples and converter assemblies for the CRAF and Cassini program. Staffing and qualification of production operators, acquisition of materials, and development of production procedures will be completed in FY 1991. Full scale production needs to commence by FY 1992. Plutonium 238 fuel fabrication and Neptunium 237 target fabrication facilities are being made operational. These efforts will continue and be increased to support the start of Pu-238 pellet fabrication by January 1992. Actual production of Np-237 targets needs to commence in 1990 and continue in the outyears to support Pu-238

production schedules required to support hardware delivery schedules for NASA and DOD missions. DOE is planning to produce Pu-238 at the Savannah River Site. Pu-238 cost reimbursement from NASA should be resolved in FY 1990 and will be reflected in outyear budgets.

The Final Safety Analysis Report (FSAR) for the Ulysses mission, prepared in cooperation with NASA, will be issued in early 1990. The shuttle launch of the Ulysses spacecraft is scheduled for October 1990. Launch support and contingency planning activities will be provided to directly support the successful launch of the Ulysses spacecraft. As was the case for the Galileo mission, the Interagency Nuclear Safety Review Panel (INSRP) will conduct an independent analysis of the FSAR and other information to support the decision process to launch the Ulysses spacecraft. DOE is supporting INSRP's efforts.

In FY 1990, two radioisotope units, one flight and one a backup unit, will be shipped to the Kennedy Space Center and mated with the Ulysses spacecraft. DOE will continue to conduct long-term performance tests (life tests) on a qualification unit to confirm reliability and power predictions for the Galileo and Ulysses missions while they are in transit to Jupiter and the Sun, respectively. In FY 1991, the qualification RTG will be systematically dismantled and analyzed. The Pu-238 fuel will be recycled for use in the CRAF/Cassini program. The backup Ulysses flight RTG will be returned to the Mound Facility after launch for monitored storage until it is required for the CRAF mission in 1995.

Preparation of production facilities along with the staffing and qualification of operating personnel will continue for CRAF and Cassini program requirements. In FY 1991, work will begin by the Systems Contractor to cover interface activities with NASA's Jet Propulsion

Laboratory and activities will be initiated to bring the converter manufacturing process to production readiness. Procurement of special graphite and other heat source materials will proceed in 1991, along with qualification of heat source production operations including safety tests and analyses.

In planning for future NASA missions, DOE is continuing to pursue the technology and development of an advanced modular RTG (MOD-RTG) feature that assures ready adaptability to a wide range of power levels. Work will continue in 1990 and 1991 on a new multicouple design to be produced and assembled into a ground demonstration system (GDS) assembly in FY 1992. A near term application is the NASA Solar Probe mission, which will be pursued in concert with NASA/JPL. This mission is identified by NASA as a Major Mission in their current five year strategic plan.

DOE will continue in FY 1990 efforts to improve heat source and converter performance and safety, improve production efficiencies to reduce costs, and pursue long-lead development areas, especially in the thermoelectric materials area. A contract will be awarded in FY 1990 for the design of a state-of-the-art RTG shipping container. This design should be completed in FY 1991 and will be used to support the testing and analysis necessary to secure a Certificate of Compliance for transport.

RADIOISOTOPE POWER SYSTEMS FACILITY

In FY 1989, DOE began the detailed design of construction modifications to the Fuels and Materials Examination Facility (FMEF) at the Hanford, Washington site to provide a Radioisotope Power Systems Facility (RPSF) that meets safety, environmental, security, safeguards, and seismic requirements for nuclear facilities. In FY 1990 the detailed design will

be completed and construction modifications will be initiated along with procurement of long lead items. Full scale construction operations and system checkouts should be completed in FY 1991.

SPECIAL APPLICATIONS

To meet DOE obligations to deliver RTGs for terrestrial national defense missions, the Special Applications program will continue its efforts to develop and demonstrate the necessary technology and to produce devices that meet user requirements. During FY 1990, DOE will continue design and integration studies for specific missions, conduct reliability testing, and provide refurbishment and production services for High Performance Generators. Tooling requirements for modifications at the Mound Facility to support the fueling, assembly, testing, and delivery of a 180-watt RTG will also be completed in FY 1990. A 2-watt electric prototype RTG will be produced and placed on long-term reliability tests. Production of 2 watt electric RTGs will commence in FY 1991 consistent with User Agency requirements and delivery schedules. DOE will also continue ongoing production and refurbishment activities, and initiate the safety qualification of a new, small terrestrial unit.

TURBINE ENERGY CONVERSION SYSTEM

The Turbine Energy Conversion System program, which has been conducted to provide higher power level radioisotope power sources, is being terminated in FY 1990. FY 1990 funding will provide for an orderly closeout of program activities.

28-321 O—90——31

URANIUM SUPPLY AND ENRICHMENT

The Department's uranium enrichment enterprise is a vital part of the nuclear industry. Its mission, as a business within the U.S. Government is to produce and sell uranium enrichment services worldwide. Our efforts to revitalize the nuclear option involve placing the uranium enrichment enterprise on a more competitive footing. The Department operates two facilities that enrich uranium for commercial nuclear reactor fuel and for naval reactors. Approximately 90 percent of the $1.5 billion in annual revenues from this business comes from the commercial sector.

Today we have approximately 50 percent of the commercial world enrichment market. Although this makes us the largest single supplier, we face increasing competition and must constantly innovate to retain our market share. To compete more effectively against foreign providers of enrichment services, we believe that it is necessary to restructure the uranium enrichment enterprise in the United States and have proposed legislation to create a Government-owned enrichment corporation. In the meantime, we are taking steps to improve the efficiency of the enterprise and concentrate on environmental responsibilities. During FY 1991 our efforts will focus on these two important areas - environmental responsibility and competitiveness in the world enrichment market.

In uranium enrichment, safe and environmentally acceptable plant operations in full compliance with all laws and regulations are priority considerations. In June of last year, Secretary Watkins announced a ten point initiative to strengthen safety, environmental protection, and waste management activities at DOE production, research, and test facilities. In order to improve the quality and uniformity of enrichment operations, a comprehensive standard for conduct of operations, like that used for

commercial nuclear powerplants, has been issued and is being applied at both enrichment facilities.

A key element of the FY 1991 President's budget, as well as legislation submitted by the Administration to Congress to create a Government corporation for uranium enrichment, is the creation of a Decontamination and Decommissioning (D&D) fund in Treasury. It is planned that about $50 million each year of uranium enrichment revenues will be transferred to this fund. We believe that monies for D&D should be set aside starting in 1991 if there is to be a sufficient amount available when enrichment facilities reach the end of their expected useful lives. The FY 1991 President's budget proposes appropriation language that would establish a D&D fund in Treasury. If legislation is passed creating a Government corporation, this fund would become available to the corporation for D&D activities.

In FY 1991, the enrichment enterprise plans to spend more than $90 million to upgrade and bring active sites into compliance with environmental requirements. This is equivalent to approximately 30 percent of the enterprise's non-power operating budget.

During the last year, one of the Department's Tiger Teams visited our production plant at Portsmouth, Ohio. Since then, our operating contractor, Martin Marietta Energy Systems (MMES) and the DOE office at Portsmouth have made considerable progress in developing and implementing action plans to respond to the specific findings. Additionally, we have formulated an action plan to address deficiencies in some key management-oriented issues, including the tendency to focus on individual findings rather than root causes, plans for strengthening the plant's technical self-sufficiency while lessening its isolation from MMES and DOE, a change

in corporate culture, and the delineation of clear lines of responsibility, authority and accountability. For the long-term, the enterprise is establishing permanent management systems to maintain high levels of performance and institutionalize the processes associated with continuous striving for excellence.

The enterprise's efforts to improve its ability to compete in the world market will focus on several key areas. First, we will continue to provide the best value in terms of price and quality of service to our customers. We will maintain our untarnished record of on-time deliveries within specifications. Our customers know that their enrichment problems are our problems, and that they can come to us for help with unique needs.

One way to remain competitive is through the control of costs. Our contracts are long-term, but the market trend is toward shorter-term contracts. Utilities are purchasing an increasing portion of their requirements from the spot and secondary markets, opting for the price advantages that these offer. Some utilities have terminated their contracts with us for the mid-to-late 1990s, preferring instead to gamble on the continued ready availability of lower-priced Separative Work Units (SWU) at that time. In addition, the extremely low prices being offered for material associated either directly or indirectly with enriched uranium from the Soviet Union are contributing to a greater interest in short-term, spot purchases. Another factor affecting this purchasing tread involves the announcement during the last year by a European competitor, URENCO, of plans to build a plant in the United States with U.S. partners.

With production levels increasing sharply in 1990 because pre-produced inventories have been exhausted, the enterprise's power procurement strategy for FY 1991 will be to lock in low cost firm power while

maximizing the use of off-peak, non-firm power to reduce production costs. In fact, about 20 to 25 percent of the total power purchased will be supplied on an off-peak, non-firm basis. About $100 million in savings will be realized by this power purchasing method.

In the long run our best hope for major cost reductions is the successful deployment of the AVLIS technology. Accordingly, the AVLIS budget request shows the greatest proportional increase (19 percent above FY 1990) of any single expense category. Along with the $154.5 million FY 1991 budget request, the Department submitted to Congress an AVLIS Demonstration and Deployment Plan, committing to a near full-scale technology demonstration in 1992 along with the activities necessary to support the eventual establishment of a production facility. An AVLIS plant deployment decision will be made in November 1992.

To ensure an informed decision as to whether to make a transition to AVLIS production, the uranium enrichment enterprise plans to establish an industrial access program in 1990 to build a strong industrial infrastructure that can evaluate and potentially support the transition of the technology to commercial use. This will be followed by the competitive selection of a commercial deployment contractor in 1991 to ensure that sufficient and necessary industrial resources are readied to successfully build and operate a production plant, if AVLIS is shown to be economically justified. Finally, we will obtain independent assessments from an industrial review group to provide technical and business evaluations of AVLIS development and to guide us in arriving at a deployment decision.

DOE believes that the best prescription for the uranium enrichment enterprise's competitiveness is the creation of a Government-owned corporation, as a transistion to a private corporation, as proposed in

legislation submitted by the Administration. Such a corporation would be more flexible than a Government agency with respect to budgeting, marketing, contracting, and management and administration.

To provide an indepeendent analysis of the financial prospects of restructuring the Department's uranium enrichment enterprise, DOE has retained the investment banking firm of Smith Barney. We believe this independent assessment will provide both the Congress and DOE with important information concerning the profitability and commercial potential of a number of restructuring alternatives.

DOE strongly recommends passage of legislation creating a Government enrichment corporation. We urge this Subcommittee to support legislation as close to the Administration's bill as possible and desire to work closely with the Subcommittee in consideration of such legislation.

CONCLUSION

The nuclear industry has many exciting developments which we believe will lead to revitalizing the nuclear option. These developments, ranging from new breakthroughs in technologies, to improvements regarding the regulatory process, to improvements in space and military applications, point to slow but distinct growth in the nuclear industry.

Through the Department's support for civilian nuclear technology, the restructuring of the uranium enrichment enterprise, and enhanced concentration on the space and military applications of nuclear power, the United States can realize the full benefits of nuclear power.

I thank you for this opportunity to address you and would be glad to answer your questions.

STATEMENT OF

SAMUEL ROUSSO
ACTING DIRECTOR
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
DEPARTMENT OF ENERGY

BEFORE THE

COMMITTEE ON APPROPRIATIONS
SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
HOUSE OF REPRESENTATIVES

MARCH 8, 1990

Statement of Samuel Rousso
Acting Director, Office of Civilian Radioactive
Waste Management
Department of Energy
FY 1991 Appropriations Hearings

Mr. Chairman and Members of the Subcommittee:

I am pleased to present to you information concerning the fiscal year (FY) 1991 budget for the Office of Civilian Radioactive Waste Management OCRWM). It includes major activities planned for FY 1991 under the Nuclear Waste Fund program, as well as under the Civilian Radioactive Waste Research and Development (R&D) program. However, before presenting the budget, by way of background, I would like to review some of the major events of the past year.

In 1989, Secretary Watkins initiated a comprehensive review of the Civilian Radioactive Waste Management Program in an effort to address concerns -- shared by Congress and utility representatives -- related to the program's schedule slips, problems in management structure, and lack of integrated contractor efforts. The results of that review were summarized in the Secretary's "Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program" submitted last November. The Secretary concluded that the program and supporting activities have a sound scientific basis but could not be executed effectively under existing management initiatives and structure. A new management action plan was established to focus on three major activities:

- o developing and implementing a new management structure;
- o obtaining the necessary permits at the Yucca Mountain site in Nevada to initiate detailed scientific investigations as the focus of site characterization to evaluate the suitability of the site for development of a repository; and,

- developing options to ensure timely acceptance of spent fuel through the establishment of a monitored retrievable storage (MRS) facility.

Significant steps are being taken to restructure the program and to work toward the development of an environmentally safe and efficient nuclear waste disposal system. I will discuss briefly the progress DOE is making to implement the Secretary's new management action plan.

MANAGEMENT RESTRUCTURING

Several important actions have been taken to establish improved management structure and procedures. They are as follows:

The Secretary selected -- and the President has nominated -- Dr. John W. Bartlett to direct the Civilian Radioactive Waste Management Program. His confirmation hearing before the Senate Committee on Energy and Natural Resources was held on February 5. The Committee approved his nomination on February 21, and he is now awaiting full Senate confirmation.

Direct-line reporting from the Yucca Mountain Project Office to DOE Headquarters also has been established to facilitate the management and execution of the program. Formerly, the Project Office reported to the Under Secretary through the Department's Nevada Operations Office. Now, the Project Office will report and be accountable directly to OCRWM.

At the direction of the Secretary, an independent management review of the Civilian Radioactive Waste Management Program was undertaken. The results of that internal review will be submitted to the new Director, when confirmed. An interim realignment, however, is now being

implemented to focus efforts on major projects and on the development of supporting management plans and procedures.

Also, an intensive review of contractor support is being conducted to eliminate overlapping efforts and identify activities that could be deferred, cancelled, or consolidated in light of the program's current schedule, priorities, and level of funding. The contract review will provide the data base for a reduction in the number of contractors assigned to specific tasks. Efforts are focusing now on the management and scope of contractor support requirements at the Yucca Mountain Project Office, at OCRWM Headquarters, and at supporting DOE Operations Offices.

Of special note, the Secretary's comprehensive program review included a detailed reevaluation of the overall program schedule -- that is, the schedule for the repository, the MRS facility, and the transportation program. As a result of the review -- and for the first time since enactment of the Nuclear Waste Policy Act -- milestones have been established that are based on a realistic assessment of activity durations and past experience. Three schedules, which track three major program phases, have been made available for public review and comment:

- a near-term schedule that sets a course for the program's activities over the next 15 months;
- a longer-term schedule that identifies scientific investigation activities through the year 2001 -- the earliest time that the Department now expects that a repository license application could be submitted to the Nuclear Regulatory Commission; and
- a revised reference schedule that extends out to the year 2010 -- the earliest date that the Department expects that a repository could begin operating.

While the revised schedules reflect a delay in the expected start of repository operations from the year 2003 to 2010, I think this is no surprise to this Subcommittee nor to anyone knowledgeable of the challenges faced in this program. The earlier completion dates were unrealistic, overly optimistic, and were not based enough on scientific and institutional reality. While I cannot guarantee that there will be no future delays in this project, the dates contained in the proposed schedules are based on sound estimates of technical duration and on scientific requirements.

COMMENCEMENT OF SCIENTIFIC INVESTIGATIONS AT YUCCA MOUNTAIN

Based on the restructured program and schedule, the Department's new emphasis will be on implementing a two-step process for assessing the suitability of the Yucca Mountain site. Initial efforts will focus on surfaced-based evaluations to assist in the early identification of potentially disqualifying conditions. Initiation of surface-based activities would be followed by the development of an exploratory shaft facility (ESF); this phased approach is planned to allow resolution of ESF design and quality assurance issues. Previous schedules included plans to begin exploratory shaft construction at Yucca Mountain in November 1989 and, at the same time, conduct surface-based testing. Environmental permits are required to do this surface-disturbing work.

The Department has been attempting to carry out the 1987 amendments to the Nuclear Waste Policy Act, which requires DOE to characterize the Yucca Mountain site. Actions undertaken by the State of Nevada, however, have prevented us from carrying out the direction of Congress and have clearly added delays to the program. Cooperation

and direct negotiation with the State of Nevada is, of course, the preferred approach to proceeding with these Congressionally-mandated scientific investigations, but the State has refused to cooperate. In fact, Nevada enacted a law that it claims prohibits the storage or disposal of high-level nuclear waste in Nevada.

Moreover, last December the State of Nevada returned DOE's permit applications unprocessed. Federal law requires DOE to characterize the Yucca Mountain site to assess its suitability as a geologic repository, but current Federal law also requires DOE to obtain permits from the State to conduct such work.

On January 5, 1990, the State of Nevada filed a lawsuit against DOE in which it contends that the Nevada legislature has effectively "disapproved" Yucca Mountain as a potential repository site under the Nuclear Waste Policy Act and asks for an order directing DOE to terminate site characterization activities at the Yucca Mountain site. To break this impasse, on January 25, 1990, the Department of Justice filed suit for DOE against the State of Nevada seeking a court order requiring the State to process DOE's permit applications within 30 days.

MONITORED RETRIEVABLE STORAGE

The Department continues to believe that the development of a monitored retrievable storage (MRS) facility is an integral part of the waste management system. The MRS is critical to our objective of timely acceptance of waste and allows us to meet other strategic objectives, such as timely disposal, schedule confidence, and system flexibility.

Therefore we continue to move forward with plans for implementation of the MRS.

To address waste storage needs occurring before the availability of a permanent repository, the Department is reviewing the legislative options that may be available to establish an MRS facility prior to the development of a permanent disposal site. We are also developing an MRS strategy that focuses on seeking volunteers and carrying out the institutional processes necessary to proceed. We believe the early development of an MRS facility -- with our target for initial operation in 1998 -- is critical to achieving the goal of timely acceptance of spent fuel from commercial reactor sites and to establishing public confidence in the Nation's ability to safely manage and dispose of its nuclear waste.

BUDGET OVERVIEW

With this background in mind, let me now turn to discussion of our FY 1991 budget request. To meet our responsibilities in the Civilian Radioactive Waste Management Program, and based on the restructured program and scientific investigation plans, DOE is requesting $292.8 million from the Nuclear Waste Fund, which is funded through fees paid by nuclear-generating utilities, and $0.7 million from the General Fund under the Civilian Radioactive Waste Research and Development program. The Nuclear Waste Fund request includes $193.2 million for activities associated with repository studies, which includes surface-based testing at Yucca Mountain scheduled to begin in January 1991, assuming an early resolution to the permitting impasse in Nevada. The $292.8 million request from the Nuclear Waste Fund compares to $295.2 million available in FY 1990 (Table 1).

TABLE I

Department of Energy
FY 1991 Congressional Budget Request
(dollars in thousands)

LEAD TABLE
Nuclear Waste Fund

Activity	FY 1989	FY 1990	FY 1991 Request
First Repository			
Operating Expenses	$223,700	$176,058	$183,220
Capital Equipment	0	0	10,000
Subtotal, First Repository	223,700	176,058	193,220
Monitored Retrievable Storage			
Operating expenses	15,000	3,000	10,000
Trans., Syst. Int., & E.D.			
Operating Expenses	40,800	21,700	29,980
Capital Equipment	200	300	300
Subtotal, Trans., Syst. Int., & E.D.	41,000	22,000	30,280
Program Management & Tech. Support			
Operating Expenses	71,432	65,498	57,733
Capital Equipment	700	1,500	1,600
Subtotal, Program Mgmt. & Tech. Support	72,132	66,998	59,333
TOTAL PROGRAM	351,832	268,056	292,833
Nuclear Regulatory Commission Fees	15,000	27,100	0
TOTAL NUCLEAR WASTE FUND	$366,832	$295,156 2)	$292,833
Outyear Funding Adjustment 1)			
Total Nuclear Waste Fund Outyears Staffing (FTE's)	268	249	250

1) Outyear numbers will be re-evaluated prior to formal submittal of the FY 1992 budget and either requirements will be adjusted or the amount provided will be increased based on the actual needs of the program.

2) FY 1990 reflects final Gramm-Rudman-Hollings sequester adjustments and P.L. 101-164 reductions to fund anti-drug activities.

Authorization: Section 31, P.L. 83-703, P.L. 97-425, and P.L. 100-203.

The estimates for FY 1992 and FY 1993 contained in the FY 1991 budget request are $303.1 million and $312.9 million, respectively. These represent estimates adjusted to reflect the Office of Management and Budget passback mark for outyear funding. The estimates will be reevaluated based on actual needs of the program and will be adjusted accordingly prior to formal submittal of the FY 1992 budget.

The FY 1991 budget request is designed to implement the program laid out in the Secretary's Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program. The budget request is based on the restructured program and schedule, with emphasis directed at completing near-term milestones related to those scientific investigations of Yucca Mountain focused on evaluating the suitability of the site for development of a repository.

The FY 1991 budget request for the Civilian Radioactive Waste Research and Development (R&D) program as part of the DOE Energy Supply R&D programs is $0.7 million, compared to $1.0 million in FY 1990 (Table 2).

NUCLEAR WASTE FUND PROGRAM

The three major components of the integrated waste management system being developed by DOE under the Nuclear Waste Fund are a geologic repository, an MRS facility, and a transportation system. The current reference schedule for these program elements is contained in Figure 1.

FIRST REPOSITORY

Yucca Mountain, Nevada, has been designated by the Nuclear Waste Policy Act (NWPA), as amended, as the candidate site for detailed site

Figure 1

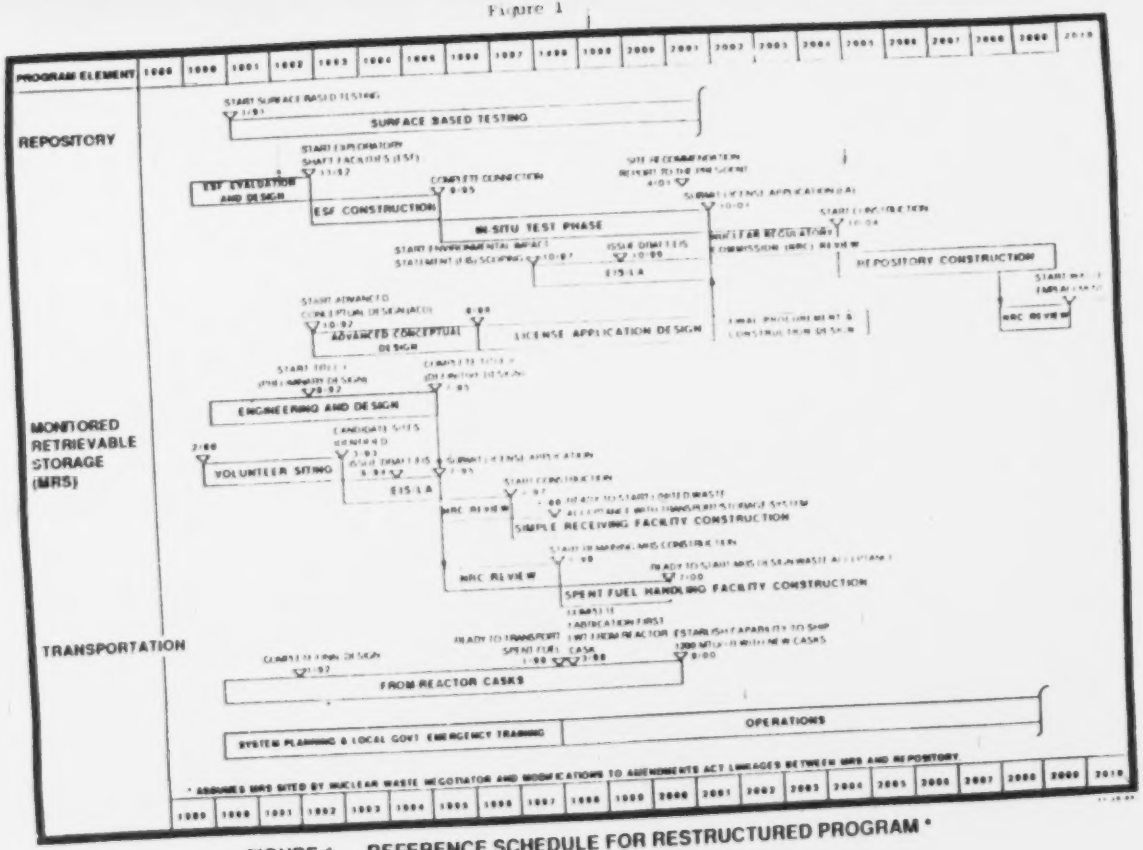

FIGURE 1. REFERENCE SCHEDULE FOR RESTRUCTURED PROGRAM *

TABLE 2

Department of Energy
FY 1991 Congressional Budget Request
Energy Supply, Research and Development
(dollars in thousands)

LEAD TABLE
Civilian Radioactive Waste Research & Development

Activity	FY 1989 Actual	FY 1990 Estimate	FY 1991 Request
Spent Fuel Storage Development			
Cooperative Agreements			
Dry Cask Storage	200	200	160
Concrete Horizontal Cask Storage	50	50	0
Dual Purpose Transport/Storage	960	0	0
Subtotal, Cooperative Agreements	1,210	250	160
Generic R&D Studies	950	500	380
Cooperation with Non-Nuclear Weapons States	50	50	50
Annual Federal Interim Storage Deployment Plan and Storage Fee Study	90	0	0
Subtotal, Spent Fuel Storage Development	2,300	800	590
Program Direction	198	200	110
TOTAL, Civilian Radioactive Waste Research and Development	2,498	1,000	700
Staffing (FTE's)	3	3	2

characterization activities, to determine whether the site is suitable for a high-level waste repository.

For repository-related activities during FY 1991, DOE is requesting $183.2 million, plus $10 million for capital equipment. This corresponds with $176.1 million requested in FY 1990. (The estimate for FY 1992 is $200.0 million and for FY 1993, $206.5 million.) The funding requested for FY 1991 anticipates a successful conclusion to the legal action with the State of Nevada and initiation of new surface-based scientific investigation at Yucca Mountain. The current schedule for completion of first repository milestones is presented in Table 3.

Major ongoing activities to be continued at Yucca Mountain during FY 1991 include non-surface disturbing work, such as seismic, hydrologic, and meterologic monitoring; studies on volcanic processes and events; laboratory work such as geochemical and rock mechanics studies; prototype testing, including prototype drilling offsite; quality assurance activities; and program managerial activities. Examples of surface-based testing activities requiring permits include drilling of deep boreholes up to 3000 feet in depth in the unsaturated zone at Yucca Mountain.

Other work will include analyses and performance assessment of waste packaging, waste forms, and waste containers; and development of systems design requirements to support design restart and performance assessment of the Exploratory Shaft Facility (ESF).

TABLE 3

SCHEDULE FOR THE REPOSITORY

Milestone	Current Schedule a/
Start of new surface-based testing	1/1991
Start of exploratory shaft construction	11/1992
Start of in situ test phase b/	9/1993
Draft environmental impact statement	10/1999
Final environmental impact statement	3/2001
IF YUCCA MOUNTAIN CANDIDATE SITE FOUND SUITABLE:	
Submittal of the site recommendation report to the President c/	4/2001
Submittal of the license application to the Nuclear Regulatory Commission	10/2001
Receipt of a construction authorization from the Nuclear Regulatory Commission	10/2004
Start of construction	10/2004
Start of repository operations	1/2010

a/ The schedule is given in calendar years

b/ In situ testing is assumed to start when the exploratory shafts are connected.

c/ It is assumed that no notice of disapproval is filed by the State of Nevada, and that the site designation becomes effective within 60 days of the President's recommendation.

During FY 1991 in the regulatory and institutional area, we will complete remaining permit applications for site characterization activities; prepare two semiannual progress reports required by the NWPA; conduct environmental monitoring activities; prepare responses to comments received on site characterization activities; and develop materials and participate in meetings with the NRC, Nuclear Waste Technical Review Board, Advisory Council on Nuclear Waste, and other groups. The request also provides for continued operation of the Yucca Mountain Information Office which opened last month in Las Vegas, as well as the Information Office in Beatty, Nevada, and contributes to project interactions with the State of Nevada and affected local governments.

We will continue to update and implement Environmental and Socioeconomic Monitoring and Mitigation Plans for the Yucca Mountain candidate site. In addition, we will continue financial assistance to the State of Nevada and affected local governments for oversight consistent with congressional direction provided in the FY 1990 Energy and Water Development Appropriations Act, and will make impact assistance payments, as appropriate.

In the area of exploratory shaft facility (ESF) design, during FY 1991 we plan to resume development of Title II (i.e., final) design packages for the Exploratory Shaft Facility. The final design packages will incorporate the information developed during the ESF alternatives evaluation.

Development of study plans for site characterization will continue throughout FY 1991. Currently, 33 study plans are undergoing DOE

review and of these, 8 have been forwarded to the NRC for its review. In addition, 35 more study plans are scheduled to enter the DOE approval process by end of the first quarter of FY 1991.

During FY 1991, we will continue to participate in international scientific activities such as Interval and Geoval, and will sponsor a second International High-Level Waste Conference in Las Vegas, Nevada. (The first such conference will be held in April 1990.)

MONITORED RETRIEVABLE STORAGE

The NWPA, as amended, authorizes an MRS facility as an integral part of the overall waste management system and places certain conditions on its siting, construction, and operation. We are currently reviewing legislative options that may be available for establishment early of an MRS. We are also developing an MRS strategy to focus on siting through a volunteer host and provides for deployment of the MRS in two phases. The FY 1991 budget request for the MRS is $10 million, as compared with $3 million in FY 1990. (The estimate for FY 1992 is $10.4 million and for FY 1993, $10.7 million.)

Major activities to be conducted during FY 1991 include continued implementation of siting initiatives; development of a grant program and provision of grants to jurisdictions to study the feasibility of siting an MRS in their jurisdiction; development of environmental background data; and, if a potential volunteer is identified, initiation of an environmental assessment. Additional activities include conduct of comparative design analyses for an MRS; systems analyses to ensure that the MRS facility is fully integrated into the waste management program; and transportation support systems studies to

ensure that the necessary transportation capabilities are in place to support MRS operations.

The reference schedule for development of an MRS is contained in Figure 1 on page 8a and a simplified schedule comparing the previous MRS schedule and current planning schedules is contained in Table 4.

TRANSPORTATION, SYSTEMS INTEGRATION, AND ENGINEERING DEVELOPMENT

The areas of transportation, systems integration and engineering development are similar in that they each cover responsibilities that cut across OCRWM program elements and components of the waste management system and, therefore, require integration of effort and of technological and institutional components. The effective development and functioning of these responsibilities is necessary to ensure safety, efficiency, reliability, cost effectiveness, and schedule maintenance in the Civilian Radioactive Waste Management Program.

The FY 1991 request for activities related to transportation, systems integration and engineering development is $30.3 million as compared with $22.0 million in FY 1990. (Estimates for FY 1992 are $31.3 million and for FY 1993, $32.4 million). A breakdown and futher discussion of each of these program responsibilities is as follows:

Transportation

The objective of the transportation program is to assure that a safe, environmentally acceptable and cost-effective transportation system is in place when needed to support waste management system facility operations. The transportation system will utilize the private sector whenever feasible and cost effective.

TABLE 4

SCHEDULE FOR THE MRS FACILITY *

Milestone	Previous Schedule	Current Schedule With Repos. Linkages	Current Schedule With Linkages Modified
Submittal of license application to the Nuclear Regulatory Commission	1995	2001	1995
Receipt of license from the Nuclear Regulatory Commission	1997	2004	1997
Start of MRS facility construction	1998	2004	1997
Phase I of MRS facility operational	2003	2007	1998
Phase II of MRS facility operational	N/A	N/A	2000

* Schedule given in calendar years

During FY 1991, DOE is requesting $19.9 million (out of the $30 million for transportation). (This compares with $17.7 million requested in FY 1990). Major activities to be conducted in this area include completing final designs and issuing reports on two transportation cask designs; conducting drop and design verification tests; and continuing cooperative activities with regional and national organizations. In addition, DOE will continue to conduct a pilot inspection program and initiate the development of transportable storage systems for Phase I of the MRS

Systems Integration

The objective of Systems Integration is to ensure integration of the planning, design and operation of all the necessary components of the waste management system. The approach to accomplishing this objective includes: identifying and baselining technical requirements for the total system; maintaining a current description of the system, components, and interfaces that meet requirements; and enhancing coordination among respective program elements.

During FY 1991 we are requesting $7.0 million for Systems Integration activities, as compared with $3.8 million in FY 1990. Systems integration activities to be conducted include conducting systems analyses of dose, cost, aggregate receipt rate, and overall system operation. In addition, we will develop technical waste acceptance criteria and develop interfaces with waste generators.

Engineering Development

The Engineering Development program develops and demonstrates cross-cutting technology required in a waste management system. One

such cross-cutting technology is the process to consolidate spent nuclear fuel assemblies on a production line basis to meet the annual throughput requirements of an MRS or a geological repository. Another such technology is development of alternative dry storage concepts for spent nuclear fuel.

For FY 1991, we are requesting $3.4 million for Engineering Development (as compared with $0.45 million in FY 1990). The main activity to be conducted in this area is to continue Phase III of the prototype rod consolidation project.

PROGRAM MANAGEMENT AND TECHNICAL SUPPORT

The activities detailed under this program element include Program Management (salaries benefits, and travel), contractual services, and technical support. During FY 1991, we are requesting $59.3 million, as compared with $67.0 million in FY 1990. (The estimates for FY 1992 and FY 1993 are $61.4 million and $63.3 million, respectively.) This level will support staffing of 250 full-time equivalents, which include:

- Headquarters OCRWM - 136
- Field 99
- Headquarters Matrix 15

The requested funding will also support activities to provide program-wide technical support in audit, fee verification, data collection and analysis. It will fund fellowship and historically Black Colleges and Universities programs, as well as fund external relations and outreach, and public involvement. It will provide funds to support the Nuclear Waste Technical Review Board, and Cooperative Agreements with the National Academy of Sciences and will fund continued interaction with

the National Congress of American Indians, the National Conference of State Legislatures, and Quality Assurance oversight. Finally, it will fund continued development of the Licensing Support System and support for the Integrated Resource Management System.

NUCLEAR REGULATORY COMMISSION FEES

The Nuclear Waste Fund provides funding for the Nuclear Regulatory Commission (NRC) tasks as delineated in the NRC Budget Request. Prior to FY 1990, funds for NRC's licensing related activities conducted in accordance with NWPA, as amended, were requested by the DOE from the Nuclear Waste Fund and paid retrospectively to the NRC. Beginning in FY 1990, and continuing in FY 1991, requests for Nuclear Waste Fund funding for NRC activities were included in NRC's budget request to Congress.

NUCLEAR WASTE FUND

The Nuclear Waste Fund (NWF) was established in FY 1983 under sections 111 and 302 of the Nuclear Waste Policy Act of 1982 (NWPA). According to section 111 of the NWPA, the NWF is "composed of payments made by generators and owners of ... waste and spent fuel, that will ensure that the costs of carrying out activities relating to the disposal of such waste and spent fuel will be borne by the companies responsible for generating such waste and spent fuel...."

Since inception, fees collected and interest earned on investments have totalled $5.1 billion. Expenditures included $945.2 million for activities associated with Yucca Mountain-related studies, $65.3 million for NRC oversight, $1.45 million for MRS Commission activities,

and $94.8 million for grants provided to affected States and Indian Tribes. Projected utility fee collections are shown in Table 5.

The NWF financial statements have been audited by an independent public accounting firm since the inception of the program. A copy of the FY 1989 financial statement which shows a more detailed breakdown of cumulative revenues earned and accrued costs of the program since inception of the NWF is included in the OCRWM Annual Report.

CIVILIAN RADIOACTIVE WASTE R&D

The goal of the Civilian Radioactive Waste R&D program is to encourage and expedite the development and demonstration of technologies for new and more efficient on-site storage capacity for spent fuel to permit the orderly continuation of electricity generation operations by the utilities prior to the availability of Federal storage and disposal facilities. The Civilian Waste R&D program is not funded out of the Nuclear Waste Fund, but instead, from the General Fund (see Table 6).

During FY 1991, we are requesting $700,000, as compared with $1 million in FY 1990. Activities to be conducted include generic research and development studies; cooperating with non-nuclear weapons states; and program management. This also supports staffing for two full-time equivalents.

SUMMARY

In summary, the Department is committed to successful implementation of the NWPA, as amended, through sound technical and institutional programs. Today, I have discussed with you a number of measures, the implementation of which will provide the necessary framework to proceed

TABLE 5

Nuclear Waste Fund
Summary of Cash Receipts and Disbursements
Cumulative Through December 31, 1989
(Dollars in millions)

Receipts	
Fees	
One-time Spent Fuel Fee	
Option 3 - by 6/30/86	$1,425.3
Option 1 - 40 Quarter payments	27.1
Total One-time Fee	1,452.4
Ongoing kilowatt-hour Fees	2,728.0
Interest Collected on Investments 1/	877.4
Total Receipts	5,057.8
Disbursements	
Disbursment for Operations 3/	2,690.9
Other Disbursement	
Interest Expense on Debt 2/	10.3
Interest Refunded to Utilities	7.6
Net Investments 4/	2,348.9
Total Disbursements	$5,057.7
Cash Balance	0.1

1/ Actual interest earned through December 31, 1989 was $655.4 million. Net gains from the sale of Treasury securities was $32.2 million.

2/ Appropriated debt of $264 million repaid 9/85.
Interest on appropriated debt paid 10/84, 10/85 and 9/86.

3/ Disbursements include repayment of debt to Treasury (appropriated debt) of $264 million.

4/ This figure represents the book value of investments as of December 31, 1989.

TABLE 6

Civilian Radioactive Waste Research and Development
Office of Civilian Radioactive Waste Management
(dollars in thousands)

Funding Activity	FY 1989	FY 1990	FY 1991 Request
Spent Fuel Storage Development Cooperative Agreements:			
Dry Cask Storage	200	200	160
Concrete Horizontal Cask Storage	50	50	0
Dual Purpose Transport/ Storage	960	0	0
Generic Research & Development Studies	950	500	380
Cooperation with Non-Nuclear Weapons States	50	50	50
Annual Federal Interim Storage Development Plan and Storage Fee Study	90	0	0
Program Direction	198	200	110
TOTAL, Civilian Radioactive Waste Research and Development	2,498	1,000	700
Staffing (FTE's)	3	3	2

with scientific investigations, to gain public confidence in our ability to develop and manage this important national program, and to assume our proper role as protector of the public health, safety and environment in civilian radioactive waste management.

TUESDAY, MARCH 6, 1990.

SOLAR AND RENEWABLES, ENVIRONMENT SAFETY AND HEALTH, ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT

WITNESSES

J. MICHAEL DAVIS, ASSISTANT SECRETARY, CONSERVATION AND RENEWABLE ENERGY

PETER N. BRUSH, ACTING ASSISTANT SECRETARY, ENVIRONMENT, SAFETY AND HEALTH

LEO P. DUFFY, DIRECTOR, OFFICE OF ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT

Mr. BEVILL. The committee will come to order.

Mr. Brush is caught in traffic; however, we will proceed. The Chair will recognize Mr. Davis at this time.

Your prepared statement will be made a part of the record and you may proceed as you wish.

SOLAR AND RENEWABLES

Mr. DAVIS. Thank you, Mr. Chairman, members of the committee. I am pleased to present the Fiscal Year 1991 budget request for renewable energy programs. We are proposing a research and development program that is focused on the needs of the marketplace, in the short, immediate, and long-term.

The request before you is $176.8 million, an increase of 55 percent over our request last year and 27 percent over our Fiscal Year 1990 appropriation.

I would like to summarize what I consider to be the highlights of the proposed renewable energy program beginning with the electrical generation sector.

ELECTRIAL GENERATION

Renewable energy currently provides 9 percent of the Nation's total energy supply and 12 percent of our domestic electrical energy generating capacity, trailing only coal and nuclear energy in our fuel mix.

Future growth in the demand for electricity will provide an opportunity for renewables to compete with other technologies for both peak and base load power generation. Many regions of the country are operating on low reserve margins, and without intensive conservation efforts, the United States may need to add as much as 110,000 megawatts of electrical capacity by the turn of the century.

There is a range of renewable energy technologies available to help meet our future electric generation needs. For renewable technologies addressing the generating sector, the Fiscal Year 1991 budget request totals $119.5 million, as compared to the Fiscal Year 1990 appropriation of $105 million. The request will support ongoing core research efforts in photovoltaics, wind, solar thermal electric, advanced geothermal, and electrochemical storage necessary to advance these options toward commercial viability. Certain research paths, as for example in ocean thermal energy conversion, are being deferred as part of our effort to sharpen our research focus, and work in the Solar Buildings area is being consolidated with ongoing buildings work under Energy Conservation.

HYDROPOWER AND WASTE COMBUSTION

In addition, the budget includes funding for two proven options in need of immediate assistance. Participants in the national energy strategy process pointed out that hydropower and energy from municipal waste are caught in regulatory tangles to such an extent that their future contribution is in question.

Some 3,000 megawatts of installed hydropower capacity is scheduled for relicensing over the next 10 years, making more acute the need to establish a predictable and factually oriented set of licensing requirements. We have, therefore, proposed a $1 million effort to characterize the hydropower resource, regulatory process, and technical requirements; and $2.5 million to fully characterize the energy and environmental outputs of municipal waste combustion, disposal, and recycling. We believe that these efforts will establish an improved factual basis for planning and regulating these energy resources and will serve as a catalyst to draw together the many involved interests, in order to reach a consensus on the appropriate balance between competing policy objectives.

PHOTOVOLTAICS

The photovoltaic (PV) energy program has achieved success in meeting its technical milestones through a combination of strong research and a cost-shared cooperative development program with industry. This public-private cooperative effort achieved seven world records for conversion efficiency in 1989. More significantly, the U.S. for the first time in five years regained world leadership in PV sales from Japan. We believe that industry, supported by the right mix of R&D, will be in a position to compete for future peak load capacity by the midterm. As technology advances are made and as photovoltaics are supported by effective energy storage or hybrid systems, we expect the industry to begin to compete for future intermediate and base load power requirements.

Our Fiscal Year 1991 request responds to these opportunities with a $43.6 million proposal that would augment continuing core research and development with initiatives designed to more effectively translate laboratory advances into industrial commercial practice and help the PV industry reduce manufacturing costs in order to open new markets.

HIGH TEMPERATURE SUPERCONDUCTIVITY

Nationally, we lose about 8 percent of the total electrical energy we generate in the transmission and distribution grid. High-Temperature Superconductivity (HTS) may one day eliminate many of these losses and may lead as well to highly efficient generators, storage devices, and motors. Recent advances in this area have led to a worldwide technological race, with huge potential markets at stake.

To support U.S. industry in exploiting the potential of HTS, the Department has coupled laboratory applied research efforts with an innovative mechanism to foster industrial development of new HTS technology. We are doing this through HTS Pilot Centers that seek cooperative R&D projects with the private sector. The initial response to the pilot centers has been very encouraging. In little more than a year, the three pilot centers have engaged in 20 collaborative agreements representing an industrial investment of $5.8 million in return for a DOE investment of $4.5 million.

In addition, we believe that industrial participants have committed substantial additional resources in areas related to these collaborations, outside the formal agreements. The progress and the wide scale industrial response to date warrant an increase in this subprogram from $12 million in Fiscal Year 1990 to $21 million in Fiscal Year 1991, including increased support for the HTS Pilot Centers from $6 million in Fiscal Year 1990 to $15 million in Fiscal Year 1991.

TRANSPORTATION FUELS

The U.S. transportation sector depends on petroleum for nearly 95 percent of its fuel requirements; it represents a singularly important opportunity for renewable energy to make strategic contributions in support of national security, environmental, and productivity goals. Even assuming reasonable levels of further efficiency improvements, the increasing number of vehicles and total miles driven annually suggest that petroleum demand may increase between 7 and 22 percent over the next 15 years without development of alternative fuels and propulsion systems.

Our Fiscal Year 1991 request for renewable energy technology to meet transportation sector needs totals $30.9 million, almost double our Fiscal Year 1990 request, and seeks to establish biomass-derived alcohol fuels as viable supply options by the turn of the century. The department also seeks to develop the supporting hydrogen and fuel cell technologies which will be instrumental to the widespread attractiveness of biomass-derived alcohol fuels through the long term.

Approximately one-third of the U.S. output of carbon dioxide (CO_2) comes from the combustion of petroleum for transportation. Among the many alternatives we have available, one is unique in its ability to contribute almost no net CO_2 as a transportation fuel. This alternative would be a program to grow energy crops specifically for transportation fuel, and convert this biomass to alcohol.

While the combustion of alcohol does release CO_2, the growth of the energy crops absorbs CO_2 from the atmosphere, yielding a near-zero net effect. Such a program would have the additional benefits

of exploiting the productivity of the Nation's domestic agricultural and forestry community to achieve pressing energy and environmental objectives, as well as the chemical engineering expertise of the oil refining industry.

SOLAR DETOXIFICATION

In the last two years scientists in the Department's research programs have discovered that concentrated solar energy enhances certain chemical reactions, creating new surface properties in materials and efficiently decomposing complex hydrocarbon chains.

One of the potentially most significant applications of this discovery is the solar detoxification of hazardous waste. Initial experiments have shown that many toxins can be broken down into harmless by-products without the substantial energy costs of the sophisticated incinerators that are now used. This is an application with great potential national importance—we produce about 280 million tons of hazardous waste each year.

To capitalize on this discovery, the Department has completed a small concentrator facility at SERI and modified concentrator facilities at Sandia to focus sunlight specifically for experiments on these new photochemical processes. In Fiscal Year 1991 we propose to increase the funding for this R&D effort from $4 million in Fiscal Year 1990 to $8.6 million.

SOLAR ENERGY RESEARCH INSTITUTE BUILDING

In research support activities, the Fiscal Year 1991 energy budget request includes funding for activities needed to support the strengthened and accelerated R&D program. Foremost among these is the need for a new laboratory building at SERI, replacing existing leased space that was originally built as an office building and can no longer support photovoltaic and related materials science research. The new $20 million facility will allow for state-of-the-art research and development and will provide the user facilities needed for the strong cooperative program with industry that is fundamental to the success of the renewables program. For Fiscal Year 1991, $4.5 million is requested to complete Title I and Title II design and begin construction.

INTERNATIONAL PROGRAMS

The Fiscal Year 1991 budget also includes increased funding for international programs to assist the renewables industry in penetrating overseas markets. The modularity and indigenous nature of renewable energy sources make them attractive candidates internationally, and the increased use of renewable energy in developing countries will pay multiple dividends, including reduced competition for internationally traded oil and a significant contribution to global environmental quality.

The U.S. renewables industry is poised to compete for this increasing market, and the international program, under the auspices of the interagency Committee on Renewable Energy Commerce and Trade (CORECT), will work to help industry capitalize on these opportunities, with a particular focus in Fiscal Year 1991 on markets in Pacific Rim nations.

Mr. Chairman, in conclusion, we are proposing a balanced yet aggressive program in renewable energy research and development, and we have some very exciting initiatives under way. We are redirecting our program to play the key role it deserves in our emerging national energy strategy, and together with our program in energy efficiency, we are investing in critical components of our energy future.

We have tried to assess the relative benefit of these varied components and fund them accordingly, by end use and by time frame. We will continue to improve our understanding of relative benefit with each succeeding year. Your support in providing the flexibility needed to manage the program is critical in this regard.

I appreciate your time and attention, and I would be pleased at this time to answer any questions you may have.

Thank you very much.

[The statement of Mr. Davis appears at the end of the hearing record.]

Mr. BEVILL. Thank you, Secretary Davis, for your presentation.

ENVIRONMENT, SAFETY AND HEALTH

Secretary Brush, the Chair will now recognize you. Your prepared statement will be made a part of the record. You may proceed as you wish.

Mr. BRUSH. Thank you very much, Mr. Chairman.

I am Peter Brush, Acting Assistant Secretary for Environment, Safety and Health and I am here to talk about our 1991 Fiscal Year budget request for that office.

Let me begin by apologizing for my slight tardiness. I assure you we did leave the office on time. It is simply underestimating the time it takes to get here these days.

Mr. BEVILL. And at the beginning I announced that you were tied up in traffic. We can all relate to that, so you are all right.

Mr. BRUSH. I appreciate your forbearance.

Mr. Chairman, the activities that are going to be carried out by the Office of Environment, Safety and Health stem largely from the June 1989 Secretary Watkins' announcement of a 10-point plan that is designed to move the department aggressively forward towards full accountability and compliance in the area of environmental, safety and health.

I have described these in detail in my detailed statement and I would like to focus on our program for Fiscal Year 1990 and how this fits in with our 1991 budget request.

COMPLIANCE ASSESSMENTS

As a direct result of the Secretary's 10-point plan, my office is focusing on a number of new priority efforts. A program of independent tiger-team compliance assessments has been started to assure compliance with applicable environment, safety and health requirements. These assessments form the cornerstone of the department's overall plan to create a new culture of self-assessment and accountability.

Conducting a tiger-team assessment typically requires 30 highly skilled and experienced professionals and involves four to eight

weeks of on-site activities as well as three to four weeks of preparation and follow-up.

We have completed these special assessments at the Rocky Flats Plant, the Field Materials Production Center, the West Valley Demonstration Project, the Y-12 Plant, Pantex, Mound, Portsmouth, the Nevada Test Site, Kansas Plant and Pinellas Plant.

Tiger-team assessments are ongoing at the Livermore National Laboratory and at the Savannah River site. Fundamental changes are being made to better manage the environmental, safety and health programs and to take an aggressive approach in interacting with regulators to address environmental concerns identified in those assessments.

In order to further improve these assessment capabilities, we have developed a training course for tiger-team participants. This course, along with a guidance manual currently under development, and field and program participation on the tiger-teams will assist the entire DOE system in performing the functions that the Admiral deems necessary for operational excellence.

OCCUPATIONAL SAFETY AND HEALTH

Another important part of the 10-point plan is establishment of an aggressive program in the area of occupational safety and health and providing integration of DOE's epidemiology programs with the worker health and safety program.

Efforts are under way to provide increased emphasis in the relationship of radiation protection, medical surveillance and epidemiology studies. We have been working very closely with the Occupational Safety and Health Administration and last fall we entered into an agreement with OSHA under which OSHA compliance officers have participated in the tiger-team inspections of three different nuclear facilities.

We have recently agreed also with OSHA to establish a comprehensive training program so that DOE can more effectively monitor workplace safety, emphasizing areas such as workplace hazard evaluations and workplace compliance reviews. This latter agreement—in this latter agreement, OSHA has agreed to conduct a comprehensive review of our worker safety oversight program.

NEPA COMPLIANCE

Improving the Department's compliance with the National Environmental Policy Act is another high priority under the Admiral's 10-point plan. The comprehensive review of the Department's NEPA policy has been completed and a new policy was recently approved by the Secretary that underscores his personal commitment to protection of the environment and compliance with NEPA.

Among other things, the policy affords early involvement of host-state governors in the process and directs revisions in our NEPA practices to assure that the public is better informed regarding proposed DOE projects.

Our office is to issue proposed revisions to the NEPA guidelines as draft rules for public comment under the Administrative Procedures Act. When finalized, our procedures will be codified for the first time as DOE regulations.

SAFEGUARDS AND SECURITY

In addition, Mr. Chairman, under the reorganization established by Secretary Watkins, our office will shortly be assuming responsibility for inspecting and assessing the effectiveness of the Department's safeguards and security policies, programs and implementation in the field and for the safety certification of packages for shipment of DOE radioactive material.

Mr. Chairman, our Fiscal Year 1991 budget request is $97.4 million, which is an increase of nearly $11 million over the 1990 appropriation as adjusted to reflect the organizational realignments which the Admiral has made in the area of nuclear safety.

Our budget fully reflects Secretary Watkins' priority emphasis on environment, safety and health oversight.

This concludes my oral presentation, and I would be pleased to answer your questions, Mr. Chairman.

Thank you.

[The prepared statement of Mr. Brush appears at the end of the hearing record.]

ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT

Mr. BEVILL. The Chair recognizes Mr. Duffy.

Mr. DUFFY. Mr. Chairman, I appreciate the opportunity to appear today to discuss the Department's Fiscal Year 1991 budget request for Environmental Restoration and Waste Management.

The Department of Energy (DOE) faces the largest environmental cleanup problem among the Federal agencies. For more than 40 years, DOE mainly through its defense production activities, introduced quantities of radioactive and hazardous chemical pollutants into the soil and surface water. These problems resulted from 40 years of emphasis on production, far too often at the expense of the environment.

To change this, Secretary Watkins, as Assistant Secretary Brush has stated, has initiated a new operating philosophy at DOE and is implementing a 10-point plan to better manage the Department's responsibilities in the areas of environmental protection, public health, worker safety, and waste management.

The Secretary's principle guideline is that there must be compatibility between our DOE mission to produce defense materials and the protection of health and the environment.

DOE can only be considered successful if we provide the materials necessary for the defense of the Nation without insult to the environment or injury to public and worker health and safety.

FIVE-YEAR PLAN

In March 1989, Secretary Watkins directed the Department to prepare an Environmental Restoration and Waste Management Five-Year Plan as a means of gaining a better understanding of the specific cleanup and compliance criteria required in the near term, as well as the cost of those actions.

The initial Five-Year Plan was issued in August 1989 and is the cornerstone of the Department's short- and long-term strategy to consolidate and coordinate DOE's cleanup activities.

The Five-Year Plan consolidates cleanup activities in the areas of Defense Programs, Nuclear Energy and Energy Research; treats them as a unified program, and establishes an agenda for compliance and cleanup against which progress will be measured.

The Five-Year Plan identifies three specific compliance-related activities. Corrective Activities denotes activities necessary to bring facilities into compliance with applicable local, State and Federal regulations. Environmental Restoration includes the assessment and cleanup of surplus facilities and inactive sites. Waste Management involves the treatment, storage and disposal of wastes generated as a result of ongoing operations and environmental development at active facilities.

Technology Development of new and improved technologies for waste minimization and cleanup is carried out to support the goals of each of these three areas. The proposed Fiscal Year 1991 budget closely follows the structure of the Five-Year Plan.

Secretary Watkins has also created an atmosphere at DOE that is encouraging constructive criticism. DOE invited representatives chosen by the Governors of Colorado, Idaho, Kentucky, Nevada, New Mexico, Ohio, Oregon, South Carolina, Tennessee, and Washington to review the Environmental Restoration and Waste Management Five-Year Plan while it was being developed.

In addition, the plan was reviewed by elected leaders of the Yakima Indian Nation from Washington State and the Shoshone-Bannock Tribe from Idaho, representatives from the National Conference of State Legislatures, and the National Association of Attorneys General.

The plan was reviewed for its technical content and approach by the National Academy of Sciences' Board of Radioactive Waste Management. DOE also sought EPA and the Office of Management and Budget views, and we have attempted to address the concerns expressed by all of these groups.

An update of the Five-Year Plan is well under way and includes expanded public review. The revised Plan's structure follows the presentation of the existing Plan but adds new sections on technology development to direct scientific and engineering resources to address environmental compliance needs and outlines transportation management requirements.

We are also expanding the external review process. Ten states and two Indian nations as well as participants from a large cross section of the public, including unions, industry associations, public interest groups and environmental groups, have been added to expand the external review process. The revised Five-Year Plan will be the subject of public meetings in May 1990.

SINGLE APPROPRIATIONS ACCOUNT

Establishing a single appropriations account is not meant to change the congressional oversight for the Five-Year Plan activities, but we consider this consolidation may assist the committees in their oversight by focusing all the expenditures in environmental restoration compliance and waste management in a single account.

Secretary Watkins also established a new line program organization within the Department which is identified as part of the reprogramming now before the Committee.

The Secretary appointed me to serve as director of the Office of Environmental Restoration and Waste Management.

FY 1991 BUDGET REQUEST

The FY 1991 budget request for priorities one, two and most of three in the Five-Year Plan is $2.79 billion, which is a $573 million or 26 percent increase over the Fiscal Year 1990 level. It is almost $1 billion in excess of the original request in 1990.

The budget continues the rapid acceleration of cleanup of DOE activities started by President Bush's allocation of $300 million in addition to the Fiscal Year 1990 budget, and Congress' action to apply an additional $357 million for Fiscal Year 1990.

It is very significant that the Fiscal Year 1991 budget now at $2.79 billion is approximately 1.26 billion over the previous initial Fiscal Year 1990 budget. It also recognizes $142 million reductions, which we think will be achieved in slippage of the projects in Fiscal Year 1991, given the large number of individual projects that we have; over 1500; and probable delays which we are experiencing in getting approvals of remedial investigation plans and closure plans and acquiring the technical and administrative staff needed by us and the States to administer this large compliance program. As examples, we are experiencing delays in gaining needed regulatory approval such as community relations, plans for remedial investigation work plans, facility investigation plans and closure plans.

A specific example of cost reduction is the Savannah River cooling tower project. It will not be as costly and we will utilize $16.6 million as part of the Fiscal Year slippage adjustment. This program is comprised of the following actions in the area of waste management operations.

WASTE MANAGEMENT

The goal of waste management operations is to assure the safe, effective treatment, storage and disposal of radioactive wastes. In Fiscal Year 1991, the request for waste management is $1,652,312,000. That is an increase of $404 million over Fiscal Year 1990. This 32 percent increase includes $298,719,000 for activities required to support activities necessary to comply with RCRA, hazardous waste regulations and meeting formal agreements with regulators and upgrade the conduct of our sensitive operations.

It also includes an increase of $71,890,000 for initiating construction of the Hanford Waste Vitrification Plant, upgrading the Idaho tank farm, the start of a transuranic and low-level waste treatment facility at Hanford, and the start of other construction projects.

Finally, there is an increase of $34 million for the Plutonium-Uranium Extraction facility used in support of waste management activities at Hanford beginning fourth quarter in Fiscal Year 1991.

WASTE ISOLATION PILOT PLANT

The Waste Isolation Pilot Plant, a major project of the Department was expected to open in the fall of 1990. In 1989, excuse me, in June 1989, the Secretary announced that the facility would not be ready to open as planned due to his concern that safety and technical issues were not being addressed adequately.

In October the Department completed a draft decision plan on WIPP, which identified the activities that needed to be completed satisfactorily before opening. The Secretary will not set a date for opening WIPP unless he is confident that preoperational activities, many outside the Department's control, can be completed successfully.

Significant progress has been made as the Secretary announced within the last week. We are also pursuing cooperative efforts with the States to assure safe transportation to WIPP from the various corridor States.

The final draft plan for the WIPP test phase, a performance assessment, was released in December 1989. The plan is expected to be issued in 1990 and the engineering design of the tests is under way with fabrication to be completed this summer.

A final activity requiring significant effort over the past year is in preparation and consists of a No-Migration Variance Petition to EPA in accordance with RCRA's present provisions. This was not anticipated in the original WIPP operation and has been a major engineering effort over the last year. It also included a waste analysis plan which consists of process flow diagrams, to detail hazardous waste constituents present in the waste stream.

A final retrieval plan is also being completed, and EPA's proposed decision on a petition is not expected until April on a technical basis, and final decision late in September.

The current land withdrawal permit issued by the Interior Department expires in 1991. This does not authorize transportation, storage, and emplacement of radioactive materials at the site. The Administration is currently planning to submit legislation for the withdrawal of the land to Congress shortly.

ROCKY FLATS PLANT

We have been deeply involved with the mixed transuronic (TRU) waste storage at Rocky Flats. It has been a major project over the last six months to change the methodology of waste generation at Rocky Flats and to look forward to alternatives in storing waste in case the WIPP project does not open in time.

WASTE VITRIFICATION

For high level waste vitrification, we continue to make progress in our plans to transition from high level waste stored in tanks to a vitrified solid. We are transitioning from tank storage to secure steel canisters at both the defense waste processing facility at Savannah River and the start of construction at Hanford.

COMPLIANCE AGREEMENTS

Major portions of our efforts in the last six months have been devoted to compliance agreements. We have executed agreements at several of our sites with the Federal EPA and cognizant State authority. We have multiparty agreements with the host-state and EPA regions at several of our sites.

Since February, we initiated nine agreements and we are presently conducting negotiations for an additional eleven.

CORRECTIVE ACTIVITIES

The corrective activities represent the smallest program cost, $168 million. Most of this funding is for the near term, 1990 to 1992, reflecting a need for program action to bring operational facilities into compliance.

In the environmental restoration area, the objectives are to perform remedial action, decontamination and decommissioning activities, and confinement in accordance with legislative authorized programs.

This includes characterization of the sites as to human health and environment. The Fiscal Year 1991 budget is $882 million for these activities. In the area of facilities and sites, there are several areas of intense effort in 1990 regarding completion of cleanups under RCRA and CERCLA. These are responses attributed to the Department's interactions with the States and EPA.

These agreements are being negotiated with all States that host departmental facilities and provide funding to the States for increased oversight. We are also progressing with more specific agreements and state regulators regarding cleanup activities at our sites.

As of the end of Fiscal Year 1989, the Department had 43 interagency agreements.

FORMERLY UTILIZED SITES

The formerly used sites are projects of remedial action conducted by DOE at former, predecessor nuclear processing facilities which are radioactively contaminated. Remedial action is the action needed at 25 sites formerly used by DOE or its predecessor organizations.

URANIUM MILL TAILINGS

Congress added four sites to the program when it enacted Public Law 98-50 in 1984. The uranium mill tailings, which is probably one of the major earth moving operations in the United States, we have over one billion cubic feet of waste that has to be contained and confined, representing 900 million tons of earth that has to be confined during this time period.

If you look at it from a geometric standpoint, it is a cube 1000 feet by 1,000 feet by 1,000 feet, which is a fantastic amount of material, all at 24 sites.

Public Law 98–50 provided for authority of remedial action. It became apparent several years ago that the work could not be completed in the seven-year period. It appears that the expected com-

pletion date of 1994 will slip by one year and the total estimated cost could increase between $50 to $70 million.

Uranium mill tailings ground water restoration will restore, as necessary, the aquifers at 24 of the sites to assure compliance with EPA ground water standards.

TECHNOLOGY DEVELOPMENT

Technology development is what the Secretary believes will be the major effort the Department has in reducing some costs associated with this gigantic cleanup program.

A separate R&D plan was issued last November. We had 60 days of comment. The public requested 5,000 copies of the document.

The Fiscal Year 1991 request of $206 million represents approximately seven percent of the overall request. DOE plans to allocate 10 percent of the resources in the future to technology development in the out years but recognizes that sometimes it is necessary to build a needed infrastructure in which to conduct these initiatives.

Demonstration activities are under way for treatment and disposal of reactive materials, detoxification, remedial actions in situ, and plasma arc process to destroy organic materials.

We have established partnerships with the Environmental Protection Agency, the Department of Defense, the National Institute of Standards and Technology, and additional collaboration is planned with the National Aeronautics and Space Administration, the NOAA and the Department of Health.

PROGRAM DIRECTION

In Program Direction, we have gone from $5 million to $24 million to fund employees' salaries, benefits and overtime for the expanding organization to cover this operation. In conclusion, DOE is making progress in developing a systematic focused course of action to address these problems and we are doing it in cooperation with the States, the State governors, State legislators and the National Academy of Sciences.

We will have contributions from the environmental agencies in the next review of the Plan. The Plan reflects the goal of cleanup of the environment at its nuclear sites within 30 years.

One significant element of these related activities is that DOE has sought assistance of these outside agencies so we are not considered to be doing this in a vacuum.

It represents a significant change in the way the Department conducts its business. Achieving progress in implementing these measures will go a long way toward gaining public acceptance of our ability to manage and operate DOE facilities safely and in an environmentally-sound manner.

Only through this difficult process will DOE, as an institution, assume its role as a good neighbor. We believe that DOE can and will achieve its important national security objectives and still meet the national environmental laws.

Thank you, Mr. Chairman.

[The statement of Mr. Duffy appears at the end of the hearing record.]

Mr. BEVILL. Very good.

SOLAR AND RENEWABLES

Secretary Davis, the proposed solar budget indicates a strengthened and streamlined effort to develop solar electric supply options. Please describe your efforts to streamline the solar program and describe how this differs from the program in Fiscal Year 1990?

Mr. DAVIS. Yes, sir, Mr. Chairman, we are looking at enhanced activities in photovoltaics. We are spending more money on this work. As I mentioned earlier, we are supporting an industry driven technology initiative.

In the photovoltaics area, we have reduced funding in the concentrator areas. In the solar thermal electric area, we have maintained that program basically at its current level. There has been some minor refocusing. We are providing more commitment to the solar detoxification activities.

Probably the only other major change within the solar electric area is that we are not requesting funding in the ocean thermal area of the budget. There is a technology there that does have potential, but when that potential is going to be available and what contribution it can actually make and how that plays off against other investments that we want to discuss, those are questions which we have tried to raise, and by our submission have indicated what our priority would be.

So we are trying to focus on those activities that industry will invest in and that are important. We are trying to balance both the near term and longer term activities in a way that is efficient.

I think it is important to note that as the environmental drivers in all of our energy issues become more obvious, there will be a need to be very careful as to how we manage what I think will be growth in all renewable technologies, particularly renewable electric technology, and we need to put ourselves in a position to manage that growth while we maintain our credibility.

As you are well aware, in years past there have been a number of different approaches, and some of those were a bit out of control in terms of what could be delivered, what it would cost, how much was the right amount to spend, what were the right activities to pursue.

So what we are trying to do now is bring DOE back to the table for these discussions and bring you a number of investments to consider as we move forward in the solar electric area.

Mr. BEVILL. You may want to expand further on that in the record.

[The information follows:]

SOLAR ELECTRIC SUPPLY OPTIONS

The proposed Solar budget indicates a strengthened and steamlined effort to develop solar electric supply options. Please describe your efforts to streamline the Solar program and describe how this differs from the program in FY 1990.

A number of technologies have reached a point at which incremental research and development investments can have substantial payoffs in reasonable time frames and these are given emphasis in the FY 1991 request. There could be significant additional hydropower resources using conventional technology if a proposed Federal program is successful in clarifying or standardizing licensing, particularly environmental licensing procedures. There could be significant benefit from increased use of domestically derived liquid fuels from biomass to help reverse our growing dependence on imported oil. Photovoltaic technologies offer large potential

benefits for domestic electric energy supply and expanding international markets; these benefits could be realized years sooner if a cost-shared manufacturing technology program with industry is undertaken. Liquid dominated geothermal resources—or hydrothermal resources—could deliver substantial capacity additions with incremental advances in technology and this area is recommended for special focus. The detoxification of hazardous waste using solar energy, and the conversion of municipal solid waste to energy offer the promise to mitigate serious national problems and provide concurrent energy benefits. These program areas have been identified for emphasis in FY 1991. Correspondingly, other program areas with less certain or longer terms payoffs have received less funding emphasis due to the constraints of the fiscal deficit.

HYDROELECTRIC POWER

Mr. BEVILL. With reference to the work in the solar program, I want to mention the hydro program. I gathered your feeling is that we are not doing enough in the field of hydroelectric power.

Mr. DAVIS. Yes, sir.

Mr. BEVILL. Do you feel that the Department of Energy, is more qualified than the United States Army Corps of Engineers? I am asking that because they do have a water experimental station. They have resources and research already going on.

Don't you think we would be duplicating to appropriate money to you to go into the hydropower field?

Mr. DAVIS. Sir, I wouldn't say that we are more qualified. I am not asserting that at all. But I would say we are in a position where we may be able to contribute to a solution.

Part of our activity that we have under way now, with existing funds, is to bring together the FERC, Corps of Engineers, and a number of other agencies to look very carefully at what the regulatory process really is and what it is, in fact, accomplishing.

At the same time we are trying to bring those agencies together to quantify what the resource really is out there, how much can be developed at existing dam sites, both dam sites with generating capacity and those without.

Now, a million dollar effort is what we propose. We are not suggesting that we replace anybody or that we have special expertise. We are suggesting that it is a problem, and we are probably in a position to bring together the right group of people to address it and answer some of these questions.

I think the answers to these questions are worth a million dollars, and I think once they are more in view, then the right actions with the right agencies at the right time should be more obvious to us all.

Mr. BEVILL. I think that more could be done in the area of improving hydroelectric power.

This is something we will have to discuss when we start our markup. It would seem that more could be done with existing dams with the installation of hydroelectric power facilities.

Mr. DAVIS. We believe that is correct, and certainly there is the challenge of balancing between water for recreational resources and water for irrigation and water for power.

Whatever the decisions are as to how much water you are going to pass through those facilities, there appears to be no question that there are technologies available to improve the efficiency of existing plants such that whatever water is finally passed through, we can produce more power.

Certainly hydroelectric power has substantial advantage in terms of environmental benefit. So it is worth looking at very, very carefully. We think this is just an initial step that will shed some light on what the real issues are.

Mr. BEVILL. We are putting money in for research to improve windmills and other solar programs.

I don't think we have anything going at this time to improve the effectiveness of the hydropower field, which is one of the very cleanest energy source. Both have their limitations but that is where research could reduce the limitations.

SOLAR THERMAL ELECTRIC TROUGH PROJECT

Are you familiar with the project out in the desert in California, about a hundred miles northeast of Los Angeles, LUZ Company.

Mr. DAVIS. Yes, sir.

Mr. BEVILL. Have you been there?

Mr. DAVIS. Yes, I have.

Mr. BEVILL. I was very impressed with it. I went out there one Sunday morning with the president of the company and I was very impressed to find they are operating in the black.

As far as I know, it is the only solar project in the Nation that is operating in the black. Is that a fair statement?

Mr. DAVIS. Sir, I don't know that I could actually answer that specifically. There are a number of solar installations in the Nation that I personally know of because I had something to do with design, installation and sales of them that operate in the black.

Mr. BEVILL. Is that the LUZ?

Mr. DAVIS. No, sir. There are activities that I am aware of in solar energy to produce domestic hot water for rural rental housing and Farmers Home Administration.

So there are a number of solar activities that are operating at some level of success.

As far as the solar thermal field is concerned, I believe you are correct that the LUZ facility is the one example in this country where you have an enterprise that is operating in the black, but I would say further that it is certainly assisted by both PURPA opportunities, which helped create a market for that power, a market that is based on the avoided cost for electricity, and also certain tax incentives, Federal and State incentives.

There is no question, however, that this particular company has made substantial progress in bringing down its cost of power such that, as various incentives have fallen away, it has become more competitive. But it still enjoys a Federal tax credit of 10 percent and certain special conditions in terms of power purchase agreements with certain California utilities for avoided costs.

Those purchase agreements are over a 10-year time frame which is advantageous.

Mr. BEVILL. Well, for your information they certainly give the U.S. Department of Energy a great deal of credit for the research that you did before they actually went into it. They were most complimentary of the Department of Energy for its work.

ENVIRONMENT, SAFETY AND HEALTH RESTRUCTURING

Mr. Brush, would you describe the significant restructuring and reorganizing of the environment, safety and health programs in Fiscal Year 1991?

Mr. BRUSH. Be happy to, Mr. Chairman.

The reorganizations, which we have explained in our testimony, result from the Secretarial decision, numbers 6 and 6(a) issued last summer and fall.

The principle point of that reorganization, as it relates to the nuclear safety oversight functions within the Department, reflects his conclusion, based upon advice received from our office and many others at the time he came into the Department, that there was a real lack of ability within the Department's line organizations to effectively oversee their nuclear safety responsibilities in the field.

What we had, frankly, was a situation in the Department where the internal oversight function was very well developed within the Office of Environment, Safety and Health for nuclear safety, but that our findings and the results of our assessments were not properly carried out by the line organizations that have responsibility to run those facilities.

This was profoundly disturbing to Admiral Watkins, because of his history and experience within the military. He was insistent that he needed the responsibility within the line organizations, people in the field, to adequately deal with nuclear safety issues.

In addition to this problem, we saw on the horizon the fact we had coming into place, and is now in place, the new Defense Nuclear Facility Safety Board, a new action of the government external to the Department whose responsibility is to oversee the nuclear safety aspects of the Department's functions.

Therefore, the Admiral determined that he wanted as a first priority to transfer to the line organizations the first responsibility to ensure compliance with the orders and regulations related to nuclear safety.

This will involve in the first instance the creation within each of the line organizations, Defense Programs, Nuclear Energy and the others, new offices of self-assessment. This is a very positive development because it will ensure that the Office of Defense Programs, for example, will for the first time in many years have the technical capability to carry out its principle responsibility for ensuring nuclear safety and that that responsibility isn't somehow shifted to another oversight body.

At the same time, the Admiral recognized the need to have within his own office, a small group which is dedicated to ensuring, that the nuclear safety self-assessment offices work effectively; and that there is good interface with the external oversight bodies such as the new board, the Advisory Committee on Nuclear Facility Safety and the many other groups both within the Congress and elsewhere that are interested in these issues.

Now, in realigning nuclear safety oversight, that also gave him the opportunity to focus the efforts of my office in some of these other safety areas that, frankly, have not received the attention they should have received. That is why we are going to be focusing our efforts in the areas of occupational safety and health, radiation

protection and the other kinds of day-to-day safety issues that apply throughout the Department's complex, not just nuclear facilities. We are finding in the tiger-team assessments that we have significant problems with worker health and safety at some of the nonnuclear sites that we are responsible for in the Fossil Energy area and other areas of the Department.

So that is the basic rationale for that.

We will be shortly presenting to the Admiral's office a new organization for my office which will focus on these areas of occupational safety and health, radiation protection and improved medical programs.

SAFEGUARDS AND SECURITY OVERSIGHT

The one other area I would mention, Mr. Chairman, involves the new responsibility which I noted in my oral testimony that we will be taking over in the area of safeguards and security oversight. This is an area that has been of great interest to the Congress and the organization that exists now is within the Office of Defense Programs, there is a unit responsible for safeguards and security programs. They write the policy. They are actually responsible for conducting those programs.

There is a need for independent oversight of that. That function currently is performed by a separate office in the Defense Programs area. That office called the Office of Security Evaluations will be moved from Defense Programs to my office so the Admiral will have an independent check of the safeguards and security programs.

That is a summary of the changes that we anticipate.

ACTINIDE BURNER FOR WASTE MANAGEMENT

Mr. BEVILL. Mr. Duffy, to what extent is the research on the use of an actinide burner as a solution to the waste management program funded in your technology development budget?

Mr. DUFFY. We are aware of the potential for actinide separation and transmutation and have looked at the various labs that were working on that process, one was ETEC in California, another was the Hanford Laboratory, and additional work is also being done at the Idaho National Laboratory.

We convened a meeting of all the program coordinators and looked at the potential for the actinide separation. It is in the embryonic state at the present time.

The ETEC facility has qualified as less than the pilot plant model but has processed on a continuous flow basis a few grams of material for separation. It has demonstrated the chemistry of the product and it is doing analysis of the individual components.

The PUREX and TRU process at Hanford has processed on a continuous basis about a thousand grams. The Integral FAST Reactor program at the Idaho National Engineering Laboratory, which is in the design stage, is to develop a process for transmutation in the reactor.

We see this as a major program of the future, but it is, again, embryonic. We are putting $26 million into the program for the next three years to develop a data base which will indicate wheth-

er or not we can go from the present laboratory scale to production scale operations.

If we can, it represents a significant reduction in the amount of material that would have to go to a geologic repository. In fact, it would give us the capability of taking out the fission product, long-lived parts, and separate the small concentrations of transuranic and actinides in the single wall tanks and double-wall tanks in the high level waste. We would then be able to put it into an above-ground storage for a thousand-year custody rather than putting it into a geologic repository for 10,000 years or 100,000 years. To demonstrate control for that long a time is highly questionable based on the history of man being less than 5,000 years as far as written recordation.

But we see it as a benefit and we see it as a 3 to 10 year program.

Mr. BEVILL. The Chair recognizes Mrs. Smith.

Mrs. SMITH. Thank you, Mr. Chairman.

Welcome, Mr. Davis, Mr. Brush, and Mr. Duffy.

ETHANOL FUELS

We are delighted to have you here. I want to tell you that Secretary Watkins has visited my State of Nebraska twice in the last six months and he has heard a great deal about ethanol, a great deal about this new alternative fuel.

So it is music to my ears, Mr. Davis, to hear you talk about ethanol.

You know, in former years, Mr. Chairman, I couldn't find the word "ethanol" in the Department of Energy materials.

Here on page 7, you point out——

Mr. BEVILL. You saw to it that it got into the dictionary.

Mrs. SMITH. Well, you and I have been working on it.

Here, I see on page 7, you say that your request for renewable energy to meet the transportation sector needs total $30.9 million—that is almost double your 1990 request—and seeks to establish biomass derived alcohol fuels as viable supply options, at the turn of the century.

Isn't this a new initiative?

Mr. DAVIS. I think it is new in terms of the emphasis and the context we are placing on it, and it is certainly new that we are working with the Department of Agriculture to shape this program properly.

We are very excited about our relationship that is currently developing with the Department of Agriculture to work this program together.

Mrs. SMITH. I am very excited about it, too, and I note on the next page you speak about energy crops specifically for transportation fuel and I would like to ask you, Mr. Davis, what crops?

Mr. DAVIS. Ma'am, certainly there is a lot of grain available, and if it is not needed as food, then it certainly can be considered for fuel.

Mrs. SMITH. There certainly is. You know we have nearly 40 million acres that are idle at the present time. They will start coming back in in just two or three years and American farmers are itching to grow a product, not surplus.

So I am interested in how many acres you envision by the turn of the century we could use for energy crops.

Mr. DAVIS. Ma'am, I would like to respond in a more detailed way to that question, and I think it also is appropriate for us to expand our relationship with the Department of Agriculture and get their ideas and views on that so that when we give you a number it is a number that has good credibility and broad support.

Mrs. SMITH. Maybe you can do that for the record.

Mr. DAVIS. We will certainly try and do that.

[The information follows:]

ACRES OF FARM LAND IN ENERGY CROPS

In 1982, the U.S. Department of Agriculture reported 154 million acres of land with a medium or high potential for being used for farm land but which was in use for pasture, range land and forest. That report is being updated, and while it is not yet published, preliminary indications are that 4 million acres have been removed from the inventory. The Biofuels program has assessed that land and believes that 92 million acres could be captured for energy crop growth.

In addition, a task force of the Secretary of Agriculture has identified the need for the conversion of 150 million acres of land now in active farm use to new crops by 2010. I understand from them that this need arises from the increased productivity of world agriculture. Again the Biofuels program has assessed this land and believes that 103 million acres could be redirected toward energy crops. The amount of land that is converted to energy crops will depend on market forces, such as the value of land for other purposes, and the new crops developed for other uses, such as high value chemicals.

Over ten thousand acres of farm land are currently devoted to short rotation wood energy crops in the U.S. The 350 million bushels of excess corn coverted to fuel ethanol last year was grown on 3 million acres. Development of the technology to convert cellulosic materials into ethanol by the turn of the century is the focus of one of the initiatives recently announced by the Department. The cellulosic materials will be based on genetically engineered, fast growing wood and herbaceous crops tailored not only to the region of the country where grown but also to the conversion process used.

Mrs. SMITH. Pursuing what crops, I note in your budget document that you speak about herbaceous feed stock. Is that a new name for corn, Mr. Chairman.

Mr. BEVILL. Well, you know, it could be. I remember in the beginning of the program on ethanol that Dr. Schlesinger, the first Secretary of Energy, came here encouraging use of ethanol and gasohol. I told him I was a country lawyer for 16 years and I said, you know my main clients were moonshiners. I also like to represent them because they could pay their lawyer. I am sentimental about the moonshiners, and I said does that mean my old clients will be able to get back in the business of moonshining? He said no question about it, they have the known technology.

Mrs. Smith, you and I have been pushing it ever since; haven't we?

Mrs. SMITH. We sure have.

I am very anxious about what crops. Do you envision this as more ethanol or more methanol?

ETHANOL AND METHANOL PRODUCTION

Mr. DAVIS. I don't think that from a Department of Energy point of view we are ready to answer that question. There are a lot of ways to make methanol, but we are looking at both methanol and ethanol from biomass.

We can get the methanol from thermochemical conversion; we can get the ethanol from biochemical conversion. We believe we have a fairly balanced program to look at both, but in all cases, ma'am, we are looking at biomass materials as feed stock to produce ethanol or methanol.

Mrs. SMITH. I notice you say $22.8 million for research in those two areas. I am very pleased.

The budget document identifies not only herbaceous feed stock but also woody species like poplars, for diesel fuel. The budget talks about sweet gum, American sycamore, silver maple. Are those biomass or methanol?

Mr. DAVIS. We look at all those as biomass feed stocks. We are trying to develop the bioconversion technology so that we not only can work with grains like corn where we convert starch, but we can work much more effectively with the cellulose that we see in other feed stocks and convert that efficiently to methanol or ethanol.

Mrs. SMITH. Two more questions on that subject.

What research is ongoing to help us learn how to produce ethanol more economically?

Mr. DAVIS. That is an effort we have under way at the Solar Energy Research Institute, and the scientists there assert the technology we need to do that, to begin to look at competitive prices at the turn of the century, the science we need to do that, we have in hand.

The question is can we begin to move that from a very laboratory-controlled environment to industrial production?

We are aiming at that with our initiative. We want to work with the Department of Agriculture, we want to involve the oil companies and the expertise there because a lot of that conversion is chemical engineering.

We believe we have the expertise that we can bring to bear on that question. To put it in context, currently ethanol is about one percent of our total transportation fuels, and it is going to take a long time and a very careful effort to increase that share substantially.

But clearly as the Clean Air Act appears to be moving towards reformulated gasoline, it appears that there is major promise to look at biofuels as a way of helping some of our liquid petroleum fuels, certainly as a way of extending them and also reducing the environmental impact of their use.

Mrs. SMITH. I noted that in Secretary Watkins' document, he says research and development activities are directed to increasing the quantity and quality of energy crops tailored for specific land areas of the United States, $6 million.

I appreciate all those comments.

Are there any efforts being made for new applications for ethanol?

Mr. DAVIS. Primarily at this time, we are looking at the conversion to liquid fuels. I think we will address that in a fairly focused way before we move on to other opportunities.

LOW-LEVEL NUCLEAR WASTE

Mrs. SMITH. Then one question on a different subject.

How have you been working with the States in the establishment of low-level nuclear waste facilities?

Mr. DAVIS. Ma'am, I would have to defer that question to probably one of my associates.

Mr. Duffy.

Mr. DUFFY. The Department's responsibility is to provide technical assistance to the States in identifying economics and waste generation and methodologies. We also provide seminar programs throughout the year to bring the States and compacts interested in discussing the problems of locating sites together and that is basically the responsibility of the Department.

We will do anything to support the States from a technical standpoint. All they have to do is request it.

Mrs. SMITH. I appreciate that.

Would you, for the record, Mr. Duffy, provide a discussion of the effort nationwide with particular attention to the Five State Compact of which Nebraska is part?

Mr. DUFFY. I will.

[The information follows:]

LOW-LEVEL NUCLEAR WASTE FACILITIES

The Department of Energy's National Low-Level Waste Management Program provides States and compacts assistance in fulfilling their responsibilities under the Low-Level Radioactive Waste Policy Amendments Act of 1985. We have provided help in project management, quality assurance techniques, waste disposal technology evaluation, performance assessment, and economic analysis, to name just a few areas. This assistance is provided in a variety of formats, including conferences, workshops, special reports, and hands-on training. In addition to this assistance which is provided across the board, the program has also responded to a number of requests from individual States to address technical issues specific to the State's activities. For several years, the Department has supported meetings of State and compact officials responsible for developing new disposal sites. We plan this year, to assist the States and compacts in forming their own independent organization through which common issues can be addressed and an effective national system for management of low-level radioactive waste can be put in place.

A minority of State officials involved with low-level waste issues has urged that the Department of Energy take action to reduce the number of disposal facilities being developed. I believe that such initiative must come from State leaders committed to this objective. Recently, the Northwest and Rocky Mountain Compacts, without involvement by the Federal Government, entered into negotiations that are expected to result in an interregional agreement to share a disposal facility.

States and compacts are proceeding at varying rates in fulfilling their responsibilities under Federal law to provide for disposal of their low-level waste. In October 1989, California became the first State to submit a license application for a new facility for the Southwest Compact region. At the other extreme, however, a number of States and compacts have not taken the steps necessary to develop new disposal capacity by the mid-1990's. We expect that if disposal access at the currently operating disposal facilities is ended on January 1, 1993, as allowed by the Act, a large number of waste generators will likely have to store their low-level waste onsite for a number of years.

The State of Nebraska has made notable progress as the host State for the central compact. The Compact's disposal site license designee selected an area in Boyd County, Nebraska, as its preferred location for the facility. Prior to receiving a license, the company must demonstrate to the Nebraska Department of Environmental Control that the proposed facility will be able to successfully isolate the waste from the environment. This site characterization effort generally takes a year or more. In Nebraska, as in other States, the idea of low-level waste disposal leads to public concerns because so few citizens are aware that technology currently exists to

safely dispose of this kind of waste. We encourage citizens and elected officials to obtain objective information about low-level waste and its disposal from a variety of sources before settling on a position on these issues.

Mrs. SMITH. Thank you. I have more questions for the record.

Mr. BEVILL. They will be answered on the record.

The Chair recognizes Mr. Thomas.

SAVANNAH RIVER GROUND WATER SEEPAGE BASINS

Mr. THOMAS. Thank you, Mr. Chairman. Gentlemen, thank you for being with us this morning.

Report language in last year's energy appropriation bill requested the Department of Energy to formulate a plan, including a schedule for the permanent isolation, containment and removal of the contaminants of the seepage basins at the Savannah River site.

The actions are to provide assurance that radioactive or hazardous materials cannot migrate into surface or ground water.

It was requested that this plan be given to this subcommittee by December 15, 1989. I wonder if you gentlemen could advise me on the status of this report at this time.

Mr. DUFFY. Yes, sir, Congressman.

That report came in the end of last month. It was not satisfactory for forwarding. I sent it back for rework. It will be to the Committee within four weeks.

I could give you an up-to-date status of the actions that are going on in the F&H-Basin and M-Basin.

Mr. THOMAS. I would appreciate you providing me with updates. I would be interested if it is not a lot of trouble, but four weeks from now you think we can expect the report?

Mr. DUFFY. Yes, sir.

Mr. THOMAS. I would like to hear your update.

Mr. DUFFY. At the M-Basin, we have a pumping operation going on to take the TCE from the 20,000 parts per billion (PPB) down to a thousand PPB where we are at the present time. It has to go down to one PPB; that is over a 20-year period.

We also are about two-thirds into the stabilization of the M-Basin itself from the standpoint of retardation, confinement and containment. That is a methodology where we take the material out, stabilize it and put it back and put a cap over it to reduce the end-leakage from the precipitation.

We started the F&H-Basin remediation programs, which is a major program for Savannah River. It is over a four-year period.

We are in the process of construction on that operation right now.

Mr. THOMAS. What kind of research, if any, is being conducted in an effort to find alternatives to the useage of seepage basins at SRS for removal of tritium in the water.

Mr. DUFFY. We have a tritium treatment facility for treating tritium in the operation it turns out that, to be perfectly honest with you, if you are going to treat tritium, the best place is to find an aquifer that is not a drinking water aquifer or otherwise useful aquifer. Because tritium has a 12.3 year half-life. In 120 years, it is down by a factor of almost a thousand. So as a result, it disappears as a product.

Unfortunately, in the gaseous form when it is released into the atmosphere, it comes back in rain and is distributed immediately into ground water. So you have a higher concentration of tritium as a result of releasing to the environment than you have by injection into the ground.

Unfortunately, we have not, to the satisfaction of the EPA, identified the methodologies by which we can do that, to inject it into the ground.

Mr. THOMAS. I would point out to you that any time you mention the word "aquifer" in my part of the country, the antenna goes up immediately.

Mr. DUFFY. That is why I said not a drinking water aquifer, but if you look at injection wells in Texas, for example, they are into a saline solution that is not used for anything. In fact, the first No Migration Petition was granted to injecting hazardous waste into the salt domes in Texas.

Mr. THOMAS. What level would that aquifer be in Texas?

Mr. DUFFY. As I remember, it is in excess of 5000 feet.

Mr. THOMAS. But in the farthest stretch of our imaginations, there is not in any foreseeable time that we might need to use that water?

Mr. DUFFY. No——

Mr. THOMAS. Or take the salt out of it?

Mr. DUFFY. It is saline and it would not be used for any drinking water operation. If you could find that aquifer somewhere, that would be the place to put it.

SAVANNAH RIVER COOLING TOWER

Mr. THOMAS. I have noted the Savannah River cooling tower will not be as costly, dropped from $44 million estimated cost to $21 million. That ought to be mighty good news.

I would like to ask you, though, what assurances can I get from your Department that this cost drop is not indicative of short cuts or steps that would limit the effectiveness of the tower?

Mr. DUFFY. The original estimate was $127 million, the $44 to $28 million was in the appropriation for one year.

When we got the exact fixed price contractor for construction, it was approximately $79 million. Of the reduction from $44 million to $28 million, $16 million will be used as part of the $142 million slippage for Fiscal Year 1991.

Mr. THOMAS. Let me go back to something I mentioned a couple times.

I remember looking at one of the ore stripper wells that was removing some of the toxics from the shallow aquifers. I think four of them were operating in that area at the time.

I was up there a couple years ago and if my math serves me right, I think I was looking at the figures of something like 420 gallons of water per minute from each well operating 24 hours a day.

I asked the question, how long will be need to operate the wells and the answer came back, well, 25 or 30 years.

Mr. DUFFY. That is right.

Mr. THOMAS. I want to visit with you a second on this, and I am not here to beat up on anybody. That is not the point of this. I just want us to remember these figures when we look at what we are doing there and what is happening by being lax in our effort up to this point.

Looking at the program for vitrification, the figures say that there are approximately 34 million gallons of radioactive waste stored in underground tanks at Savannah River.

You go on to talk about the process of vitrification, designed to produce a maximum of 410 glass filled canisters annually, with each of them containing approximately 165 gallons of vitrified waste.

That process, the production estimates, show that once the facility is fully operational it would take 16 years to process the backlog of accumulated waste up there.

Mr. DUFFY. Yes, sir.

Mr. THOMAS. Here is another of these 15, 20, year or quarter century things we are getting into.

I ran a little math of my own and I didn't come up with your numbers. If you process 410 of those canisters, and they contain 165 gallons each, that is 67,650 gallons and if you multiply by 16 years, I only come up with a million gallons.

Why is my math wrong?

Mr. DUFFY. In the aspect of the 54 tanks, they have water plus a sludge base. The vitrified portion is only the sludge base.

If you look at the supernatant extraction and evaporation process we use, someone probably showed you the salt stone monoliths we are putting out for the low-level waste. There are 40 of those anticipated over the same time period. That takes the low-level and puts it in concrete, stores it above ground and that has custody requirements for 100, 300 and 500 years.

Mr. THOMAS. Can you give me the cost of that one operation over those 16 years? Could you give me a per canister cost?

Mr. DUFFY. The operation of the Defense Waste Processing Facility is about $85 million a year, plus or minus $5 million.

The operating cost per canister if you take the number over that period of time, and you look at round numbers of 6,000 canisters, it is roughly $200,000 a canister. It is an exceptionally high cost.

If we had done something different in fusion, I think the Chairman identified what are we doing in the aspect of looking at technologies in the transuranic separation and actinide separation. I think if we had started that at the time 10 or 15 years ago, we may have had a solution that wouldn't require that kind of operation.

Mr. THOMAS. Something to replace the vitrification.

Mr. DUFFY. That is right. By the year 2010, 2015, we will be in a totally different methodology. This is an archaic way of handling it, especially after the tanks are already in operation and storing waste for 20 years.

If we look at the Hanford situation, we have 150 tanks with the same situation, and we are building a high-level waste vitrification process, but it is putting it into a safer end-product in solid versus liquid in the tanks.

Any time you have liquid in the tanks, you have a leakage potential and what we are trying to do is put it in the safest condition possible with the technology we have today.

Mr. THOMAS. Of course, we still have, after we vitrify the waste, we have the glass log or canister that has to be dealt with. We are storing it there.

Mr. DUFFY. Yes, sir, in monitored retrievable storage.

Mr. THOMAS. And will it be moved to a repository when we decide where to put that?

Mr. DUFFY. Yes, sir. It is consistent with what is going on in the rest of the world. The French are doing that on the basis of about a thousand tons of vitrification a year at Le Hague and they put it in monitored retrieval storage.

The Swedes are operating under the same provision, the British, Germans, Japanese; they are all looking at monitored retrieval storage because of the problems of identifying how you take care of the repository for 10,000 years when we don't have that kind of history.

So we have to develop a credibility that the site is isolatable, it will not leak and this is what we are doing. That is why it is taking such a long time.

If you have to make a guarantee that nothing will leak in 10,000 years, as I indicated before, the recorded history of man is less than 5,000, as far as written history, it is a very difficult situation to do, especially difficult at 1150 to 2000 feet below ground.

Mr. THOMAS. I don't know. These things astound me and they do the public.

I watched a special the other night on Hanford. You may have seen that hour long program. I don't know if you saw that but it is an astounding thing.

The Savannah River is on the banks of my congressional district and influences the river and the river is the eastern boundary of my district. I went with Admiral Watkins and I am proud of his commitment and the new agenda that I sense. I have heaped as much praise as I can on that, but it is very hard to explain to people as their representative, why the devil these things ever happen. We can all say it is because of the cold war, that is a by-product of the cold war just like the great commitment we had to make in defense is. Hopefully we can talk about a peace dividend, but now we are have to pay a hell of a cost in the future for something we have already done.

If you were asked why did these things happen, was it because we didn't have the technology? Was it because of our commitment to trying to stay abreast of the Soviet threat in the nuclear arms race? How did this happen?

Mr. DUFFY. I think in the 1950's and 1960's, remembering the situation, people were digging bomb shelters in their back yards and things like that, so the mentality of the country was certainly in a defense posture mode.

I think we could have done a lot better with the environment and done it a lot cheaper if we had looked at it from the standpoint of the better technology looking towards the future.

In fact, in 1948 the safeguards review committee for the Atomic Energy Commission identified most of the problems that we have today as being problems that we would experience in 40 years, and they identified single-wall tanks discharging to the environment, not having a long-range plan for the high-level waste.

It was not as though it was an unknown. They knew exactly what would be happening in the future and I think it was put into a secondary priority because of the isolation of the sites.

In today's environment that is totally wrong.

Mr. THOMAS. I thank you gentlemen very much. I feel a heavy responsibility here. I certainly am not trained in this area. I have a degree in English literature and I am trying to understand this is very difficult and arcane material.

I am well aware we have very capable people on the staff and other members who know far more than I. But I see the congressional oversight responsibility here as one that is very heavy to me, particularly when I see the magnitude of what we are talking about in trying to clean up what we have already done. Also dealing with the cost for the future.

Thank you for your time.

Mr. Chairman, thank you

REIMBURSEMENT TO EPA

Mr. BEVILL. I understand that the DOE has provided EPA with approximately $500,000 of the funds appropriated to DOE. I understand these funds were to be used by EPA to expedite that agency in carrying out its mission.

What authority does the DOE have to transfer its appropriations to another agency to carry out that agency's mission?

Mr. DUFFY. According to our General Counsel, we were reimbursing the EPA for areas that were not included in their budget in that time frame, on support to DOE on the No Migration Petition. That is the extent of my knowledge of the legal aspects of it. According to General Counsel, it's an authorized reimbursement.

In the future, the EPA will request the specific funds in their budget submittals to Congress.

Mr. BEVILL. I wish you would get with the Counsel on that and supply a very detailed record on that because that concerns us. It seems that you are really transferring money that you don't have the authority to do. Congress has to do that.

I think that is going pretty far. I wish you would take another look at that. Submit that for the record.

Mr. DUFFY. We will supply you with an opinion from the General Counsel.

[The information follows:]

AUTHORITY TO REIMBURSE EPA

While DOE has no authority to simply transfer its appropriations to another agency to assist in funding that agency's mission, DOE does have authority to enter into an agreement with EPA under certain circumstances, whereby EPA performs a task for DOE with reimbursement by DOE.

Interagency transactions, such as the one involved here, are authority by 31 U.S.C. 1535 (the "Economy Act"), which requires the requisitioning agency (i.e., DOE) to reimburse the supplying agency (i.e., EPA) for the actual costs of the undertaking.

In the instance case, while EPA is funded to perform the type of review sought by DOE, *i.e.*, review of a No Migration Petition, EPA advised DOE that allocations of EPA funding for these services are already approaching the limits of funds available for the current and next fiscal years, and therefore funding was unavailable for the expedited review that DOE needed. Accordingly, to facilitate the high priority for EPA review that DOE's time frame for achieving operability of WIPP requires, DOE funding is crucial. The monies in question will be used by EPA to hire the additional staff and contractor support needed to help DOE accomplish its mission. Payment for this expedited review, which was necessary for DOE programmatic reasons and for which EPA had inadequate resources, was properly carried our under the legal authority of the "Economy Act."

INCREASED DEPENDENCE ON FOREIGN OIL

Mr. BEVILL. I would just throw this open to general discussion. What are oil imports now, 65 percent of the oil we use in the Nation?

Mr. DUFFY. I think the Secretary indicated 52 percent yesterday, going towards 60 percent.

Mr. BEVILL. And in 1993 they estimate it will be about 60 percent?

Mr. DUFFY. Yes, sir.

Mr. BEVILL. Let me ask you, and I will throw this open for any of you to answer, are we not losing the battle? The U.S. Department of Energy is the one agency where we approved billions for different sources of energy. We have been doing it for 13 years now. We still import more oil.

The Nation is becoming more dependent on the shaky countries in the Middle East. Doesn't that make our Nation very vulnerable from a defense and economic standpoint?

Mr. DAVIS. I think there is——

Mr. THOMAS. Don't everybody speak at once.

Mr. DAVIS. It is a very important issue.

Mr. THOMAS. Yes, it is.

ENERGY USE IN TRANSPORTATION SECTOR

Mr. DAVIS. Our demand for petroleum in the transportation sector is going up, and it is going up at a time when vehicle efficiency is also increasing.

Since 1973, new vehicles are about 90 percent more efficient than they were in 1973. But there are more vehicles on the road, there are more miles being traveled, and while those vehicles are more efficient, demand is higher.

Now, in our domestic petroleum industry, the production is going down. You have seen those numbers. That is certainly a major concern. It has to be addressed, and we really are going to be forced to look at the tradeoffs.

I don't see how we can continue to keep spending that much money offshore in terms of oil imports. So we have to do a better job, I think, in efficiency and really understanding what the tradeoffs are for our domestic production.

In a very small way, I believe we can take some of the productivity currently constrained in the agricultural sector, working with

the Department of Agriculture and working with our own oil refinery industry, and begin to see what contribution alcohol fuels and other alternative fuels can make in assisting this large demand for petroleum.

There is no way any time soon that—whether it is natural gas, whether it is propane, whether it is ethanol, methanol, ETBE or MTBE—that we have any silver bullet there. We are certainly going to have to look at what are the appropriate investments to make, what could the contributions be and get a longer term view.

We are trying to raise those issues as we develop the national energy strategy. It is clearly a tough issue.

But in the very near term, the immediate situation, it appears to be more imports.

PUBLIC CONCERNS ABOUT NUCLEAR POWER

Mr. DUFFY. I believe the Secretary mentioned yesterday one of the problems is the problem that Congressman Thomas identified, the public's lack of understanding of the total energy sources that we have available.

There hasn't been a nuclear plant ordered or built since 1976 and——

Mr. BEVILL. I believe the Secretary also said there wouldn't be any during the rest of this century.

Mr. DUFFY. That is right.

If you look at the waste situation, the public has a real fear of that situation with respect to nuclear waste, and we have the problem with respect to siting of a geologic repository and, as Congressman Thomas identified, the amount of radioactive waste kept at our sites, the low level waste compacts that Congresswoman Smith identified, they are all preventing nuclear power from being an alternative source.

I think the key thing is getting back to education and putting the risks associated with radioactive waste in comparison to the risks associated with any other type of energy source or the daily operation of an automobile, the fact that 25,000 people die every year from drunken driving accidents, the fact there are cancer deaths every year, and put those in perspective of are we going to be competitive, will we have energy for the future, are we going to be able to do this technically correct in comparison to some methods used in the past.

If we can get that across to the public in the next 10 to 15 years, we will be back on a competitive nature. If we can't economically, we will be out of business.

REQUEST FOR EDUCATIONAL PROGRAMS

Mr. BEVILL. Did you request any money for educational programs along that line?

Mr. DUFFY. Yes, sir, we have it in the R&D plan. We have about 25 million to go for a consortium with universities to education, kindergarten through twelfth grade, teachers in the science area and to work with the industries in the area of our laboratories so that when we have the cleanup operations from the low level waste and high level waste and transuranic wastes, we have students

working in the area who appreciate it and they can bring that knowledge back to their parents.

I don't think anybody is more qualified to go back and tell their parents, who probably have the least amount of knowledge in the scientific area, what the scientific capabilities are of the country other than their own children. This is the resource of the future as we see it.

Just as the Secretary indicated in his meeting in Chicago to bring the black teachers back into the scientific field, because that is the biggest resource we have, if we look at the number of blacks and minorities going into science, it is less than 2 percent, yet they represent 35 percent of the population.

If you look at the women and female population from the standpoint they have less than 8 percent yet they represent 51 percent of the population.

So we need to get an educational program that brings that resource in as an educator or applicator or implementor of the operation.

We think in the R&D area, this is a major area for the future to solve our problems so we don't get into what Congressman Thomas indicated, the same mode we are in now, cleaning up 40 years of improper handling of our wastes, whether it is from energy sources or from manufacturing sources.

If you look at the Superfund operations, it is estimated to be about $500 billion over the next 30 years. That takes a lot of research from the companies. That is bottom line economics.

If you do put it into cleanup, it is not going into research. If you don't put it into research, you won't be competitive in 5 to 10 years. So it is a major program to get science education back into the mainstream.

Mr. BEVILL. So you certainly support the Secretary's position about education. The importance of that in the long run?

Mr. DUFFY. I support the Secretary's position on almost everything, Congressman.

Mr. BEVILL. I gathered that.

Well, have you requested money for education before?

Mr. DUFFY. Well, I just came on board so I would have to say from the budget that I saw there was some funding for education but not in the area of research and development.

We think there is a major element for breakthrough in R&D.

Mr. BEVILL. Everything always comes back to more money; doesn't it?

Mr. DUFFY. I think it comes back to more effective utilization of the money. We have an area of discipline that we will have to improve on. There is just not an endless supply of money. We don't generate the money, the taxpayers do.

Mr. BEVILL. We have not seen a budget from the executive branch of the government that was balanced since the Johnson Administration. That is the last balanced budget that was submitted to us.

So we get requests for all these good things and we know they are good, we don't question it, but we have to figure out where the money is coming from. It has to come from additional revenue or it has to come from existing programs.

I am getting on another subject but it is applicable to not only your Department but to all departments in the government. It is nice to say we requested so many million for this and so many million for that and then you say the Congress didn't appropriate it.

But we are in a different position. We have to know where the money comes from.

Anyhow, we all agree we are not pleased with the progress we have made on energy and on becoming more energy independent. I think that is something we all agree on.

You may want to comment further in the record on this. I would like to get your opinions on it.

Mr. DUFFY. Yes, sir.

[The information follows:]

REDUCING DEPENDENCE ON FOREIGN OIL

The Nation's increasing chance on oil imports from potentially insecure sources is cause for concern and is being addressed as part of the National Energy Strategy. The Department of Energy, in consultation with other agencies, is examining the energy security implications of the present level of U.S. oil imports and the expected growth in oil imports over the next decade. The National Energy Strategy will be presented to the President at the end of this year.

Mr. BEVILL. Tell us what we might do to improve. I think our country is in trouble. We are headed in the wrong direction. It doesn't make any difference how many missiles or what military we have, if we don't have oil we are in trouble.

Certainly depending on shaky countries in the Middle East is not a dependable source of oil.

So we need some more solar energy. We need more hydro power. We need more of all these billions of dollars of research we have been doing for 13 years. But I don't see much in the way of results.

I hope some of your reorganization improves the situation.

I would like to see us do better. I am sure you would, too.

Thank you for your fine testimony. We will each be submitting further questions for you to answer on the record.

Mr. BEVILL. The committee will stand adjourned until 10 o'clock in the morning.

[The questions and answers for the record and the statements of Mr. Davis, Mr. Brush, and Mr. Duffy follow:]

Reprogramming

Mr. Bevill. The Committee is pleased to see the Administration provide support for the renewable energy program. I am pleased to hear of the proposed initiatives even though these initiatives sound like the activities the Committee has urged the Department to expand over the last 10 years.

I am concerned, however, that these initiatives are proposed to begin in FY 1990 and the Department has not sought the approval of Congress to change from the way the funds were appropriated.

The Committee has worked well with the Department in the past, but I want to make it very clear that the funds are to be used for the purposes appropriated unless a reprogramming has been proposed and accepted.

I am also concerned with your proposal to eliminate or greatly reduce a number of programs long supported by the Committee such as ocean energy programs and geopressure programs.

I would like your assurance that you will not divert the funds appropriated without an approved reprogramming.

Mr. Davis. I want to assure you that funds appropriated to the Renewable Energy programs are being used for the purposes appropriated and that any exception will be proposed as a reprogramming in accordance with Committee guidelines. A reprogramming notification was submitted to the Committee on February 28, 1990, to support the Department's high-priority energy initiatives and the funds will not be used for the initiatives until we have received the Committee's response.

SOLAR DETOXIFICATION

Mr. Bevill. Please expand on your program to use solar power to eliminate hazardous waste.

Mr. Davis. To meet the environmental challenge of mitigating the threat posed by toxic chemicals, the Solar Thermal Technology Program has investigated the use of concentrated solar energy to detoxify hazardous chemicals.

There are two aspects of the solar detoxification effort. One is the destruction of organic chemicals that have been dissolved in water. The second is the destruction of concentrated hazardous chemicals such as dioxins and polychlorinated biphenyls.

Water detoxification is accomplished at ambient temperatures using solar energy concentrated thirty to fifty times that of natural sunlight. Solar energy activates catalysts that reduce toxic chemicals in water into harmless products. Bench-scale experiments have proven the effectiveness of the technique for a variety of common water contaminants.

Concentrated chemicals are treated in a solar reactor at high solar concentration and high temperature. Laboratory scale tests have demonstrated that extremely dangerous chemicals such as dioxins can be destroyed to concentration limits set by state and federal regulations.

Preliminary judgement on the merits of solar-assisted detoxification of wastes has been favorable, and the Department of Energy has recently expanded its support of this program through a CE initiative.

SOLAR BUILDINGS

Mr. Bevill. Describe your proposal to transfer portions of the solar building program to another Appropriations Subcommittee's jurisdiction.

Mr. Davis. On the basis of Congressional appropriations directions in the FY 1990 Budget, the Systems Integration activity was eliminated in the Solar Buildings Program and responsibility transferred to the Office of Building and Community Systems (OBCS). The FY 1991 Budget Request transfers the cooling and daylighting activities in the Solar Buildings Program to OBCS.

The transfer of activities to OBCS will improve the Department's effectiveness in conducting research and transferring technical information to specific sectors of the building industry. For example, producers of glazing materials and window manufacturers have been involved in both the windows research program of OBCS and the solar daylighting research program of the Solar Buildings Program.

Combining these activities within the same DOE Office will facilitate close collaboration with industry, avoid redundant technology transfer efforts, and make it possible to achieve the most energy-efficient results.

RENEWABLE ENERGY PROGRAMS

Mr. Bevill. What programs funded in FY 1990 are proposed for elimination or significant reduction in FY 1991 and why?

Mr. Davis. A number of renewable energy programs offer substantial technological potential and attract significant industrial involvement and cost sharing. We have proposed to focus our resources to emphasize development of these most promising options over programs that offer either longer-range or less certain benefits. Areas in the latter category include ocean energy systems, proposed for elimination, and geopressured and magma geothermal technologies targeted for a 3 year phase down. In addition, recent advances in proton-exchange membrane fuel cells have increased their power output five-fold and caused them to become a higher priority than electrochemical cells; the electrochemical research program is important but can be sustained at a slower pace. The technology for light-weight polymer film for solar thermal applications has matured and, we believe can be assumed by industry without continued government support. We are also proposing to merge our solar buildings program into the building energy systems program which will lead to an integrated and more efficient program.

GLOBAL WARMING

Mr. Bevill. Recently there have been a number of published studies revising the rate of Global Warming and challenging the existing scientific capability in making predictions. What effect do these studies have on your budget projections?

Mr. Davis. Projections of average global temperature rise in the next 50 to 100 years due to greenhouse gases have most often ranged from 3 to 8 degrees Fahrenheit. Many early projections tended to suggest the higher end of this range while, as you have noted, certain recent estimates have favored the lower end. While we fully recognize the positive benefits of most renewable technologies with respect to global warming, these swings in projected values have had virtually no impact on DOE renewable energy budget decision making. However, the need to lessen the environmental impact of energy use does provide another important reason to focus the Federal investments in renewable energy.

OCEAN ENERGY SYSTEMS PROGRAM

Mr. Bevill. Please provide a detailed explanation to justify the elimination of the Ocean Energy Systems programs.

Mr. Davis. The Ocean Energy Systems program emphasizes development of mathematical models and their verification from experimental data for design of an open-cycle ocean thermal energy system. The system is mostly applicable to island markets. Recent tests have confirmed specifications being developed

for the final design of a 165 kWe (gross) net power producing experiment. The 165 kWe is a gross output capability. It is hoped that this output will provide for operation of the plant and thus demonstrate that net power for transmission could be produced. This design can be completed with FY 1990 funding. Further effort would require a long term commitment at substantially higher levels of funding to demonstrate scalability to larger commercial size ocean thermal energy conversion plants. By focusing resources on technologies with higher and more broadly applicable payoff and more rapid commercial development by industry, we are seeking to achieve the greater energy benefit from our current budget.

RENEWABLE ENERGY INITIATIVES

Mr. Bevill. Your budget describes a number of new initiatives for renewable energy. Please describe each of these initiatives and provide the FY 1990 and FY 1991 funding.

Mr. Davis. There are six initiatives identified for FY 1991. The Photovoltaic Manufacturing Technology Initiative involves close cooperation with the U.S. photovoltaic industry to substantially reduce the cost of manufacturing photovoltaic cells, modules, and balance-of-systems components. The goal of the initiative is to ensure that U.S. industry retains a world leadership role in the commercial and manufacture of photovoltaic systems. The Solar Detoxification of Hazardous Wastes is a new application for concentrated solar energy. This concentrated energy in combination with certain particular catalysts can destroy hazardous wastes. This may offer another solution to an environmental problem of particular importance to the

Nation and to DOE. Cost-Competitive Ethanol Fuels is an initiative to establish a coordinated public-private effort to develop fully competitive ethanol fuels from domestic biomass resources. Energy from Municipal Waste is a significant source of energy production and conservation. The expansion of its use in the near term is inhibited by a lack of information on energy, environmental and economic data on the various commercial options. Therefore, the initial effort is targeted to a cooperative effort between DOE, EPA, and industry to fully characterize the products of municipal waste combustion (exhaust gases and ash) to establish that this growing resource can be used safely and productively. Expanding Our Hydropower Contribution is an effort to work with FERC, EPA, Fish and Wildlife Service, National Marine Fisheries Service, Bureau of Reclamation, the Army Corps of Engineers, and States to understand all the implications of the existing regulatory process, streamline that process where possible and concurrently define the additional resource available at existing sites. A New Laboratory at SERI is an initiative to provide appropriate facilities for photovoltaic research and related materials research. The new building will be responsive to current and future experimental needs and will eliminate current safety and environmental risks associated with operating in a commercial office building.

The FY 1990 and FY 1991 funding is shown in a table which I would like to insert in the record. (The information follows:)

FISCAL YEAR FUNDING FOR RENEWABLE ENERGY INITIATIVES
(IN MILLIONS OF DOLLARS)

Title of Initiative	FY 1990 Funding	FY 1991 Funding
Manufacturing Technology for Photovoltaics	$ 1.7	$9.0
Solar Detoxification of Hazardous Wastes	1.8	4.5
Cost-Competitive Ethanol Fuels	2.0	5.0
Energy from Municipal Wastes	(2.0)*	2.5
New SERI Laboratory	1.0	4.5
Expanding Our Hydropower Contribution	(1.4)**	1.0
Totals	6.5	26.5

* Reprogramming request Interior and Related Agencies Appropriations.
** Self-financed from prior year hydropower funding.

Mr. Bevill. Please describe how these new solar initiatives differ from past solar program philosophy.

Mr. Davis. In general terms, the initiatives show that we are not limiting our research and development efforts to strictly long term, high risk research. More specifically, the initiatives are aimed at market oriented technology development and are characterized by strong technical and financial cooperation with industry. We are not suggesting that these or future program enhancements will replace traditional energy sources, but rather they

are steps that bring renewables forward as options to continued use of traditional supplies.

GEOTHERMAL PROGRAM

Mr. Bevill. Your new initiatives do not include the Geothermal program, and yet Geothermal is listed as a top priority program. Are there no initiatives required in this program?

Mr. Davis. The geothermal program budget for FY 1991 contains an embedded initiative. This initiative substantially increases program emphasis on assisting the geothermal industry to resolve impediments constraining development of hydrothermal resources while deferring research on the longer term geothermal resource options.

HIGH TEMPERATURE SUPERCONDUCTIVITY

Mr. Bevill. Describe the increased funding in High Temperature Superconductivity. Indicate how this program is coordinated with the program in Energy Research.

Mr. Davis. The increase will enhance the Superconductivity Pilot Center technology transfer activities, currently conducted at Argonne National Laboratory, Oak Ridge National Laboratory, and Los Alamos National Laboratory. The increased funding will support additional cost shared (50/50) research with industry.

The High Temperature Superconductivity (HTS) programs supported in Conservation and Renewable Energy are applied research and development programs which build upon the foundation generated by the HTS fundamental research activities supported by Basic Energy Sciences in the Office of Energy Research. There are several coordination mechanisms which have been established between these offices. At the field level, both basic and applied research is conducted at the same laboratories. Researchers are able to interact extensively and new fundamental understanding can immediately improve the applied work. At the Department level, coordination is done through the Energy Materials Coordinating Committee's Subcommittee on Superconductivity. An annual report of DOE superconductivity research is prepared based on their input. Elements of the DOE program also interact through coordinating committees having a broader scope, such as the Superconductivity Coordination Committee for Electric Power. This committee is co-chaired by DOE and the Electric Power Research Institute and includes the Department of Commerce, the Department of Defense, the National Aeronautics and Space Administration, the National Science Foundation, and the National Institute of Science and Technology. DOE also belongs to the Technology Insertion Working Group (TIWG) of the Strategic Defense Initiative Office. TIWG's purpose is defense power system applications, and includes all relevant parts of the Department of Defense and the National Aeronautics and Space Administration.

Mr. Bevill. Describe the specific program areas in High Temperature Superconductivity funded in Energy Research and those funded in Renewable Energy Research and describe the rationale for the division of responsibility.

Mr. Davis. The High Temperature Superconductivity (HTS) program in the Office of Basic Energy Sciences (BES) focuses on fundamental research directed toward understanding the crystalline structure, theory, physical and chemical properties of HTS materials; and characterization of the electrical and mechanical properties of materials and devices. The applied HTS research within Conservation and Renewable Energy builds upon the fundamental research activities of BES.

HTS research in the Renewable Energy program consists of two elements within the Electric Energy Systems program. One element, Superconducting Technology for Electric Power Systems (STEPS), provides funds for research and development on high temperature superconductivity for electric power applications. This includes motors, generators, transformers, transmission lines, and magnetic energy storage. These have a common theme of needing high electric current in magnetic fields. The research emphasis is on developing processing and fabrication technology for practical cables and coils from superconducting wires, filaments, tapes, and films. Participation with university and corporate research partners is a key part of this work, as evidenced by significant subcontracts and competitive solicitations. The second element of the program is the Pilot Center. The Pilot Centers are a DOE initiative to establish efficient mechanisms for collaborative R&D between the National Laboratories and U.S. industry to expedite the technology development necessary for future commercial applications of high-temperature superconductivity.

The primary purpose of these Pilot Centers is to develop enabling technologies cooperatively between the National Laboratories and the private sector.

GLOBAL WARMING

Mr. Bevill. Please provide your prospective of the Global Warming problem and the potential relief provide by solar and renewable energy.

Mr. Davis. The combustion of fossil energy sources contributes to the accumulation of carbon dioxide and nitrogen oxides in the atmosphere, both of which have been identified as greenhouse gases. In contrast, use of renewable energy systems in most cases results in little or no such emissions. A major goal of the DOE programs on renewable technologies is to increase their economic competitiveness and, thereby, to increase their attractiveness to energy system decisionmakers in all sectors of the U.S. energy marketplace. Success in improving market attractiveness will mean success in reducing the threat of global climatic change.

Mr. Bevill. Since Global Warming is perceived as an international issue, what effect will the U.S. solar and renewable energy program have on this international problem?

Mr. Davis. There is no indication that unilateral action by the U.S. will have a significant effect on this international problem. Many experts believe that reductions in U.S. greenhouse gas emissions will be offset by increases in greenhouse gas emissions from newly industrializing countries,

which will utilize relatively cheaper fossil energy sources in their quest for economic development. However, where they are justified on their own merits, we will continue to adopt energy policies which are relatively more environmentally benign.

Mr. Bevill. What is the status of the scientific research on Global Warming?

Mr. Davis. There is general consensus within the scientific community that carbon dioxide and other heat trapping gases are accumulating in the atmosphere. However, the science for evaluating and understanding the global warming potential of this phenomona needs to be improved, as evidenced by the inconsistent data resulting from current climate models. Consequently, research on the cause and effects of climate change attributable to the production and use of energy should be continued. Response strategies should be related to the results of that research.

DOMESTIC RENEWABLE ENERGY PRODUCTION

Mr. Bevill. Your budget states that 9% of the domestic energy production comes from renewable energy sources. About half of this 9% is from hydropower and the other half is from wood burning. What percentage of the domestic energy production comes from the research in renewable energy appropriated by this Committee?

Mr. Davis. Renewables of all types contributed 9% (6.54 quads) of domestic energy consumption in 1989. Hydroelectric power and the wood

processing industry contributed about 8.3% (6.1 quads) of domestic energy consumption, while the newer renewable technologies -- those currently supported by Federal research -- contributed about .7% of energy consumption (.44 quads). If equated to oil at an $18 per barrel world spot price, the newer technologies contributed the equivalent of about $1.3 billion worth of imports. The most recent Energy Information Administration forcast projects a renewable energy contribution of 10.1 quads in 2010; the majority of this 3½ quad growth is expected to come from the newer technologies supported by this Committee's appropriations. Thus in 2010 these newer technologies are expected to contribute a value of over $10 billion in oil-import-equivalent terms.

ECONOMIC COMPETITIVENESS OF SOLAR THERMAL

Mr. Bevill. How much does legislation such as PURPA play in the economic competitiveness of solar thermal projects?

Mr. Davis. PURPA has been an important factor in most existing renewable energy installations that are connected to the utility grid. PURPA has been responsible for the emergence of "standard offer" contracts that have become commonplace in California and elsewhere. It has had a major influence in the willingness of utilities to negotiate with non-utility producers of electric power. PURPA has also had significant impact on the price that utilities are willing to pay to smaller or non-firm power producers. To one degree or another, these PURPA factors almost certainly influenced the marketability of existing solar thermal electric grid-connected systems and can be expected to influence future sales as well. In contrast, PURPA does

not and was not intended to effect the marketability of stand-alone solar thermal electric systems or of solar thermal hot water or space heating systems.

SOLAR AND RENEWABLE ENERGY COST-SHARING

Mr. Bevill. Which solar and renewable energy projects currently involve or have a requirement for cost-sharing? What is the status of those cost-sharing agreements?

Mr. Davis. The development of a strong, internationally competitive industry base is a primary goal of the renewable energy programs, virtually all of which contain cost-shared agreements. In Fiscal Year 1990, about 28% of the appropriated renewable energy funding is expected to be obligated in cost-shared agreements. A measure of the support industry provides these programs is indicated by the fact that, on the average, industry adds about 60% to the Department's funding in these agreements.

ENERGY TAX CREDITS

Mr. Bevill. What has been the impact on the solar industries resulting from the loss of energy tax credits? Do you support additional Federal subsidies or tax credits?

Mr. Davis. The tax credit impact, both enactment and expiration, varied according to technology and generally correlated with the closeness of a particular energy system to market competitiveness. Photovoltaics, solar

heating and cooling of buildings, and ocean technologies offered relatively higher priced energy, and sales were not influenced in a major way by tax credits. In contrast, wind systems and solar hot water heaters, both nearly competitive with conventional systems, were stimulated into significant sales growth during tax credit years and corresponding dropoffs after expiration. However, these were some abuses of the tax credits, and the general performance of these technologies has improved since the expiration of tax credits. Following the same pattern, solar thermal trough systems combined with a natural gas backup system are in certain areas cost-competitive for peak electric power and are today the principal user of the remaining tax credits. The question of additional Federal subsidies or tax credits will be examined in the development of the National Energy Strategy now underway in DOE.

SOLAR BUILDINGS

Mr. Bevill. Describe your rationale for reducing solar heating research and capital equipment.

Mr. Davis. The solar heating research activities consist primarily of research in generic solar heating systems, advanced concepts for solar space heating, and the incorporation of thermal storage in conventional building materials. The funding requirements for FY 1991 have been reduced since much of the work in support of industry's short-term needs will be completed in FY 1990. The capital equipment funding reduction is largely a result of the proposed transfer of the cooling and daylighting activities in the Solar Buildings program to the Buildings and Community Systems program.

The current generic heating systems research focuses on the development of test procedures that could be readily applied to standardized state-of-the-art solar systems by industry at low cost and which will improve acceptance by public agencies, lending institutions, and the public. It is expected that most of this work will be completed in FY 1990, and the funding requirements for FY 1991 will be reduced.

Working closely with researchers participating in joint international efforts, the program will conduct research in innovative concepts that show promise of improved costs and performance. This activity addresses the industry's long-term needs, and, therefore, the funding requirements for FY 1991 will be increased modestly.

To optimize solar energy's contributions to buildings, advanced thermal storage materials and techniques are required to retain heat when solar radiation is abundant and to utilize that heat when sunlight is not available. The research program will focus on completing research with phase-change materials incorporated in conventional wallboards. Beyond FY 1990, industry will continue to assume a greater portion of this development effort, and the funding requirements in FY 1991 will be reduced.

Mr. Bevill. Please justify your proposal to shift portions of the Solar Buildings program to another Appropriations Subcommittee. Please provide a list and description with FY 1989 and FY 1990 funding of those activities proposed for transfer. What funding is proposed for these activities in your FY 1991 budget to the Interior and Related Agencies Subcommittee?

Mr. Davis. Combining activities of the Solar Buildings program with research activities conducted by the Office of Buildings and Community Systems, which is funded by the Interior and Related Agencies Appropriations Subcommittee, will facilitate the Department's collaborative activities with various sectors of the building industry. To illustrate, the same constituencies in that industry, such as building designers and the producers and installers of building mechanical equipment, have been closely involved in the research activities associated with cooling and dehumidification systems for buildings. These activities have been conducted by both the Solar Buildings Program and the Office of Buildings and Community Systems. Combining these activities in one R&D program will improve the Department's research effectiveness and technology transfer to the building industry.

The two major areas of research to be transferred to the Office of Buildings and Community Systems are Solar Daylighting and Solar Cooling and Dehumidification. The funding for solar daylighting was $1,735,000 in FY 1989 and $1,835,000 in FY 1990. Funding for Solar Cooling and Dehumidification Activities was $1,265,000 in FY 1989 and $1,011,000 in FY 1990.

Funding in the FY 1991 budget proposed to the Interior and Related Agencies Subcommittee for continuing the solar daylighting research activities is $1,400,000 and for continuing solar cooling and dehumidification research is $400,000.

PHOTOVOLTAIC ENERGY SYSTEMS

Mr. Bevill. Photovoltaic energy technology is one of your highest priority programs. Describe your justification for this priority.

Mr. Davis. The photovoltaic (PV) program has made significant progress over the past decades. Cell and module efficiencies have increased dramatically in every material type. The U.S. now holds numerous world efficiency records. Within the past several years, costs have been reduced by a factor of five, and module reliability has increased to twenty years. Because photovoltaics are modular, they fit into many early market applications which have allowed the industry to establish itself and grow. That industry is capable of exploiting new advances. U.S. sales grew 30% in 1989 and now represent 36% of the world market. It is due to this progress with advanced materials and processing techniques, along with an active, aggressive industry that we place a high priority on the photovoltaic program.

Mr. Bevill. Describe further your efforts in collector research attempting to improve process engineering and manufacturing.

Mr. Davis. A five-year initiative designated as the Photovoltaic Manufacturing Technology project is being developed in close cooperation with the U.S. PV industry. In this project, DOE will be acting as an R&D investment partner with industry to improve the U.S. industry's competitive position. The project will be administered by DOE and its SERI and Sandia laboratories. The PV industry and non-DOE organizations will be performing most of the research work. It is planned that about 90% of the project

funding will be spent in outside contracts. The goal is to accelerate PV manufacturing cost reduction, lay the foundation for large-scale production, and ensure that the U.S. industry retains a world leadership role in the commercial development and manufacture of PV systems. A three-month Phase 1 manufacturing problem identification activity with industrial companies and organizations is anticipated in FY 1990 to be followed by implementation in FY 1991 of a Phase 2 activity to perform the manufacturing technology research.

Mr. Bevill. Please describe your program for PVUSA and describe your future plans for this program.

Mr. Davis. The PVUSA project was initiated in 1987 for the purpose of evaluating the use of photovoltaics in a utility setting. The Department of Energy funding for PVUSA was to be matched by the Pacific Gas and Electric Company, and other program associates such as the Electric Power Research Institute, the California Energy Commission, and other utilities choosing to participate in the project. The Department provided $4M in FY1987 and $4M in FY 1988, thus bringing the total presently funded to $16M. This total includes $8 million in cost sharing, principally from Pacific Gas and Electric Company and to a lesser extent from the Electric Power Research Institute, the California Energy Commission, and several other participating utilities.

The present program includes two Emerging Technology (EMT) procurements with each contractor supplying about a 20KW system, and one Utility-Scale System Experiment procurement with each contractor installing a 200KW to 400KW system. The initial EMT awards have been made to five contractors. Three of these have been installed, and the remaining two will be installed later in

these have been installed, and the remaining two will be installed later in 1990. Additional EMT awards have been made to three contractors for installation in late 1990 and 1991. Three Utility-Scale Systems have been contracted for installation in 1990 and 1991.

No additional DOE funding has been proposed for FY 1990 or FY 1991. The Department believes that even 1991 is too early to consider additional funding for the project since portions of Phase I have slipped, and the first Utility-Scale System will not be installed until FY1991, and testing will require additional time. Reevaluation of the need for further support will be made during FY1992 budget planning. It should be noted that some utility-size systems are now being considered by others without U.S. government support.

Mr. Bevill. Please describe the FY 1991 program in PV advanced thin film materials.

Mr. Davis. The advanced thin-film materials task includes amorphous silicon, polycrystalline thin-film (particularly copper indium diselenide and cadmium telluride), and very high-efficiency, thin-film gallium arsenide materials.

In each material area, there are industrial cost-shared contracts plus supporting R&D, which is conducted at university, industrial R&D, and DOE laboratories. Re-competition of the research programs for each of these materials is in the negotiation and award stages in early 1990. Thus, in FY 1991, most of the thin-film projects will be continuing into their second

year. In FY 1991, the industrial cost-shared contracts constitute about 60% of the funds for the thin-film materials task, while about 40% is for supporting research.

Mr. Bevill: Describe the FY 1989 and FY 1990 program with the Southeast and Southwest Regional Experiment Station work and Sandia National Laboratories on test and evaluation of single-junction and tandem thin-film modules.

Mr. Davis. The Southwest Regional Experiment Station is performing activities in system performance monitoring, data acquisition and analysis, system test surveys, component failure analysis, Design Assistance Center support, National Electric Code evaluation, and educational assistance. These tasks are designed to maintain a comprehensive systems information database on design, performance, operation, and reliability of all categories of photovoltaic systems.

The Southeast Regional Experiment Station is performing tasks to test and evaluate components for stand-alone photovoltaic systems as a means of establishing the reliability of these components in various system configurations. The Southeast Regional Station also is developing a Latin American and Caribbean Training Center and conducting photovoltaic applications and procurement seminars.

The Southwest and Southeast Regional Experiment Stations and Sandia National Laboratories are testing several commercially available amorphous modules under Sandia's direction. The results of these tests are initially

proprietary and confidential and are provided back to each module manufacturer during the test period. However, at the conclusion of the test period the results of testing on commercially available modules are made available to the photovoltaic community/industry.

SOLAR THERMAL ENERGY SYSTEMS

Mr. Bevill. Please describe your FY 1990 program for Solar Thermal Energy Systems and justify your FY 1991 reductions and increases.

Mr. Davis. The Solar Thermal program conducts research tasks in four major areas: high-flux photon processes, concentrators, electric systems research, and technology development.

In FY 1991 a funding increase is requested to support High-Flux Photon Process Research. The program is based on new scientific discoveries which show enhanced process effectiveness for photocatalytic reactions. This effort includes development of a system that can be used to decontaminate groundwater of solvents or pesticides. Included in this is an increased effort in catalyst development for a broader band of the solar spectrum than the existing catalyst and which can be mounted on a matrix. There is also an increase to support the development of a reactor and modelling of chemical processes.

The Concentrator Research program for FY 1990 and FY 1991 will continue evaluating the lifetime of polymer materials exposed to ultraviolet energy and

determine effective reflector film replacement techniques. This program area will continue the development of stretched membrane concentrators.

The reduction in the concentrator program is possible because of the success with the development of stretched membrane concentrators. Contracts will be continued for the design and fabrication of prototype membrane heliostats and dishes. The heliostat program is approaching completion with only long-term evaluation of prototypes remaining.

Under Electric Systems Research, the program will continue to support dish Stirling system analysis and testing of advanced dishes and receivers. The Department will conduct testing and evaluation of reflux receivers for operation with a dish-mounted engine and pursue collaborative efforts with industry on the swashplate Stirling engine. Also in cooperation with industry, the Department plans to support the design of a free-piston Stirling engine that could meet cost and reliability requirements for utility applications. In the Central Receiver area, design and evaluation will continue on pumps, valves, and receivers.

An increase is requested in FY 1990 and 1991 for technology development. This activity has the objective of developing crucial components and performing systems tests needed for technical readiness for electric power and waste detoxification applications in major domestic markets in the mid-term.

In FY 1991 a significant funding increase is requested to support the Department's solar thermal detoxification initiative. A system experiment is planned at a DOE hazardous waste site with selection of the site this fiscal

year (FY 1990). The experiment would establish the technical feasibility of using concentrated solar energy to destroy wastes in groundwater and would be the first system experiment conducted outside of a controlled laboratory environment. The experiment would provide "real world" experience in handling waste, controlling the system, and dealing with the intermittent solar energy source (the sun). It is also planned to initiate design and fabrication activities for field systems experiment related to mid-term solar thermal electric systems.

Mr. Bevill. Justify the reduction in Concentrator Technology Research.

Mr. Davis. The major reduction relates to the development of membrane heliostats. Second generation prototype membrane heliostats have been designed, fabricated and tested. These low-cost heliostats have performed with optical efficiencies comparable to the best glass/metal heliostats even under variable wind conditions. Contracts are underway for the design and fabrication of market-ready membrane heliostats. Fabrication of these heliostats will be completed and testing initiated during FY 1990-91, with only long-term evaluation of prototypes remaining to complete the development efforts.

Mr. Bevill. Describe the status of your dish Stirling system development.

Mr. Davis. Industry has shown an interest in commercializing small dish/Stirling systems, perhaps by in the mid 1990s if the hardware can be field tested in 1992-1993. This could lead to commercial 25 KWe systems for

the utility marketplace in the late 1990s. The Department activities include design, development, and test assistance for the early systems, and research and development on the utility systems.

The Department is developing reflux receivers for Stirling engines which are a significant improvement over prior tube receivers. A prototype reflux receiver has demonstrated 92 percent efficiency at 800C. The industry has endorsed these advanced receivers due to their high reliability and long life. The Department also has been developing stretched membrane dishes to replace the heavier and more costly glass metal systems. Stretched membrane concentrators are to be tested over the coming two fiscal years. A 25 KWe Stirling swashplate engine is undergoing a two year test at Sandia. Industry is currently under contract to cost share with the Department through NASA the development of advanced 25 KWe Stirling engines by 1993 which are targeted for utility applications.

Mr. Bevill. Describe further your high-flux solar detoxification of industrial toxic waste.

Mr. Davis. The U.S. EPA estimates that 280 million tons of toxic wastes are generated each year by U.S. industries and government; less than 3% of these wastes are recycled or destroyed to established safe levels. The remainder of these wastes are stored or dumped; some of the wastes are a serious threat to land, water, and air.

The Solar Thermal Technology Program has investigated the use of concentrated solar energy to detoxify hazardous chemicals.

There are two aspects of the solar detoxification effort. One is the detoxification of hazardous chemicals in water. The second is the destruction of concentrated hazardous chemicals to regulated standards.

Water detoxification is accomplished with the aid of sunlight activated catalysts, with low solar concentrations (thirty to fifty times that of natural sunlight). Bench-scale experiments have proven the effectiveness of the technique for a wide variety of common water contaminants, such as industrial solvents and petroleum derivatives.

On the other hand, concentrated chemicals are treated in a solar chemical reactor with solar concentrations thousands of times greater than that of natural sunlight. Laboratory scale tests have demonstrated that extremely dangerous chemicals such as dioxins can be destroyed to concentration limits set by state and Federal regulations.

So far, judgement on the merits of solar-assisted detoxification of wastes has been favorable. A field experiment is being planned for FY 1991 which will be the first test of the concept at an actual hazardous waste site.

Mr. Bevill. Describe the expansion of the Technology Development program. Provide specific tasks to be undertaken in FY 1991.

Mr. Davis. The major expansion in the Technology Development program in FY 1990 and FY 1991 is the initiation of the Department's Solar Detoxification of Hazardous Waste Initiative and a field test experiment for solar thermal electric systems.

Under the detoxification initiative, site selection, system design, and analysis needed for a near-term solar water decontamination field experiment at a DOE hazardous waste site will be conducted. Such an experiment would show the capability for solar decontamination of water containing hazardous organic solvents in a field environment. Test mixtures of real chemical wastes in a high flux, high temperature detoxification system will also be undertaken including design and test of a solar detoxification reactor.

Joint venture projects with industry for the fabrication and operation of field experiments of advanced solar thermal electric systems to achieve a cost competitive electrical energy in the mid 1990's will be pursued. A primary target is expected to be dish/Stirling systems, but a joint venture could also include a viable industry proposal for central receivers.

Mr. Bevill. What programs funded in FY 1990 are proposed for elimination or substantial reduction in FY 1991?

Mr. Davis. There are no programs in the solar thermal program planned for elimination. The anticipated successful completion of particular activities in polymer research, improved silver polymer reflectors, and the reduction in heliostat development anticipated in FY 1990 will enable the program to reduce funding in the concentrator research area.

BIOFUELS ENERGY SYSTEMS

Mr. Bevill. Please describe your FY 1990 Regional Biomass program and justify your FY 1991 reductions.

Mr. Davis. In FY 1990 the Regional Biomass Program continues to provide resource assessments, region-specific analyses and applications, and technology transfer as it has for over ten years. These activities are focused on and encourage private industry to make investments in the more mature biofuels technologies which offer commercial opportunities. In addition, activities in this program provide technical assistance and emphasize cost-sharing; while promoting program integration and cooperation within and among States. The Department believes that for most biofuels technologies, the Regional Program has matured to the point where current levels of federal involvement are no longer required to sustain the momentum which has been achieved. However, the Department is undertaking an initiative to improve the utilization of municipal waste as a source of energy and energy-intensive materials. The use of proven regional program concepts are an integral part of this initiative, and therefore funds are being requested for this fiscal year. In addition, we are preparing the groundwork to utilize these Programs to facilitate the acceptance and transfer of new biomass-based alcohol fuels technology to the market place in the future.

Mr Bevill: Provide a specific detailed list of the activities proposed for FY 1991 in thermochemical and biochemical conversion.

Mr. Davis: The FY 1991 thermochemical activities include laboratory scale experiments to address issues facing methanol and high value chemical production from biomass such as synthesis gas clean up, compression, and modification of the carbon monoxide/hydrogen ratio. Other laboratory efforts will explore the issues of the gasification of herbaceous feedstocks to expand

biomass supply opportunities for methanol production. The engineering scale medium-Btu gasification facility will be designed and construction initiated. Analysis and design of equipment to prepare the synthesis gas from that facility will be initiated. Other efforts will be related to the recently announced municipal solid waste initiative. Specifically we will continue to gather comparative energy, environmental and economic data for MSW processes and will begin to fill the data gaps. The tests of calcium enhanced densified refuse-derived pellets will be completed. Research will be conducted on new approaches to MSW combustion effluent cleanup and residue stabilization for heavy metals. The biochemical conversion activities focus on research to improve the process economics of converting biomass feedstocks into ethanol. This research includes improvement of the pretreatment step for separating biomass, genetic improvement of yeast for cheaper enzyme production, understanding and controlling the regulation of cellulase production, recycling enzymes as a means of conserving all the enzymes in the conversion process, genetically engineering yeast for improved fermentation of the five-carbon sugars to ethanol, and experiments to optimize the ethanol conversion process. This year the program will begin to integrate all the process steps to establish the system economics of the conversion process.

Mr. Bevill. Explain the Department's shift in priorities in the biofuels program. What new initiatives are proposed in FY 1991?

Mr. Davis. The Department's shift in priorities for biofuels research reflects a focus on technology for the production of liquid transportation fuels that will be available to support the Nation's pursuit of clean air and domestic liquid fuel resources to replace imported oil. Thus the focus is on

biomass-based alcohols which have great potential for alternative transportation fuels in the 1990's. Also, these have significant environmental benefits such as reduced emissions of carbon monoxide and hydrocarbons whether they are used as blends, components of ethers and/or neat fuels. A further advantage is that the growth of replacement biomass feedstock for fuel alcohol essentially recycles all the carbon emitted in fuel production and use. Biofuels also have low acid gas components such as sulfur, and provide alternative crops for farmers. These are some of the reasons that the Department chose ethanol from biomass as one of its recently announced initiatives.

Mr. Bevill: What FY 1990 Biomass programs are proposed for elimination in FY 1991.

Mr. Davis. No FY 1990 Biomass programs are being eliminated in FY 1991. Two programs, Aquatic Energy Crops and Regional Programs, do have significant reductions in funding. In the case of aquatic crops, we are deferring the program in light of other nearer term higher priority research. We are maintaining our core research capability and the significant collection of microalgae that the program has developed. In the case of Regional Programs we are in the process in shifting their focus to the municipal waste and ethanol initiatives. Within the thermochemical program we are reducing our research on producing gasoline from biomass until the NES process is complete and we develop more information on the effect of gasoline on the environment. Finally we are deferring our work on anaerobic digestion in light of the extensive availability of economic natural gas through the turn of the century.

Mr. Bevill: Describe the present and anticipated hurdles that must be overcome before methanol will become a widely accepted transportation fuel.

Mr. Davis: The widespread introduction of methanol fueled vehicles represents an investment risk that vehicle manufacturers, fuel producers, and consumers have found unacceptable thus far. For auto manufacturers, the risks are associated with the retooling cost to produce alternative and flexible-fueled vehicles, and with the marketing of these vehicles in sufficient numbers to justify production lines. For the fuel industry, significant new investments would be required in methanol production capacity, and the fuel supply infrastructure would require significant modification. Since the cost of natural gas in the lower 48 States is relatively high compared to other potential sources of methanol, methanol based on natural gas will be predominantly imported. Before our domestic coal and renewable biomass resources could be used, technical and economic issues require research and resolution. In essence, car manufacturers do not want to produce the vehicles until the fuel is available, the methanol suppliers do not want provide fuel until there is a market, and consumers want neither until they can have a competitive vehicle and fuel. However, the amendments to the Clean Air Act that are likely to be enacted may well provide additional incentives that could result in the expanded use of methanol vehicles, as well as several other potential clean fuels.

Mr. Bevill: Provide a detailed description of your expanded municipal solid waste program.

Mr. Davis: Under the initiative, DOE will establish a data base on energy, environmental and economic parameters of combustion, recycling, and landfilling of municipal solid waste. Cost shared tests will be conducted to demonstrate enhanced densified refuse-derived fuel combustion in a large scale public utility boiler. The emissions from the tests will be characterized. Research will explore environmentally acceptable disposal options for combustion ash. The Regional Programs will be used to transfer the results of research to industry, local government, the public, interest groups and technical societies.

Bevill. What feedstocks are the most likely choices for your expanded bioconversion program? Explain the advantages and disadvantages of the proposed feedstocks?

Mr. Davis. The program is currently involved in research on various non-food cellulosic energy crops to expand the feedstock base beyond corn and other grains. Further, we are taking a regional approach to select feedstocks to fit the regional conditions. The two categories of energy crops are short rotation wood and herbaceous crops. Short rotation wood research has reduced over 140 potential species to 5 and is now focused on poplars, black locust, silver maple, american sycamore and sweet gum as target species. Poplars grow well in most areas of the country, and there is a higher level of fundamental knowledge about their DNA than that of almost any other tree. This simplifies the genetic modification necessary for developing highly productive clones tailored to specific regions, soil types and conversion process. Black locust is a nitrogen fixing species that does not require fertilization and may fit a reduced fertilizer strategy. The other three species provide diversity for

specific regions of the country. For example, Scott Paper is now establishing American sycamore plantations in western Alabama to provide energy for their Mobile paper plant. The herbaceous crops program is developing grass energy crops. While the final target species are now being selected, switch grass and energy cane are among the front runners for the southeast. Switch grass has the advantage of being a perennial and can be grown with low energy inputs on lands where erosion is a problem, while energy cane can be grown at high biomass yields.

Wood and herbaceous crops can be converted to energy by either thermal or chemical processes. In the end, growth cycles, harvest times and storage issues may dictate a conversion process using both as feedstocks for a single conversion system. With the supply issues aside, the lower moisture content and higher energy density of wood favors thermal conversion while the low lignin content of herbaceous crops favors biochemical conversion. The major disadvantage, and as yet an unanswered question, is whether such feedstocks be grown cheaply enough for energy production. The program believes that $2 per million Btu is a reachable goal.

WIND ENERGY SYSTEMS

Mr. Bevill. How does the Department view the international potential for sales of wind energy equipment, and what is it doing to assure the U.S. is competitive in the world market?

Mr. Davis. European countries are placing increased emphasis on wind energy as a significant candidate for generation expansion and export. Many

of these countries have turbine development programs and specific national goals for wind capacity, and several offer incentives. The Department's efforts to assure that the U.S. wind industry continues to be a major player include continued research to support industry with design tools and better understanding of the basic physics of wind energy conversion, development of improved airfoils and conceptual designs for advanced turbines, as well as support for overseas sales opportunities through CORECT and international standard-making groups.

Mr. Bevill. Describe your shifting priorities in the Wind Energy Systems program.

Mr. Davis. The Department's priorities in the Wind Energy Program have shifted somewhat in the last several years in response to industry's expression of its needs and the progress in the technology. For example, variations in the turbulence and eddys in the wind are a major concern for wind turbine manufacturers, and we are working with the industry to better characterize existing and future sites for single turbines and arrays of turbines. The most significant shift in priorities is to undertake conceptual design studies of advanced wind turbines to assist the industry in understanding how the major cost and performance improvements required for the mid-1990s and beyond could be achieved. The need for these studies, which are only just beginning, was supported by the American Wind Energy Association, individual manufacturers, windfarm operators, and interested electric utilities.

Mr. Bevill. How strong is the research capability that exists in the private sector for wind energy?

Mr. Davis. The present research capability in the private sector varies considerably among companies, and none have extensive research capabilities. With a few exceptions, the wind industry is composed of mostly small, undercapitalized firms. Several manufacturers have ceased operations in the last few years, while the remaining ones are trying to make sales and improve product. International sales competition in the last few years has limited the ability to invest in research. The DOE program attempts to leverage the capabilities in the industry by performing research cooperatively with industry wherever possible.

OCEAN ENERGY SYSTEMS

Mr. Bevill. Please describe your FY 1990 program of Ocean Energy Systems and justify your proposed elimination of the program in FY 1991.

Mr. Davis. The FY 1990 program of Ocean Energy Systems will continue to emphasize development of mathematical models and verification for open-cycle ocean thermal energy conversion (OC-OTEC) system design. Activities will include thermodynamic research and analysis and experimental verification and testing. Completion of these efforts will permit development of preliminary and final designs of a 165 kWe (gross) OC-OTEC system with FY 1990 funds.

Further effort would require a long term commitment at substantial levels of funding to demonstrate scalability to larger commercial size OTEC

plants. Availability to industry of a final design based upon validated models is an appropriate place to discontinue the program and allow industry to assess commercial viability as they have been doing with the earlier closed-cycle concept. We believe that focusing on technologies with high potential payoff, broad applicability, and significant industry involvement is a more effective use of budget resources.

Mr. Bevill. Your budget states that close-out activities will be initiated in FY 1990. When will the Department submit a proposed reprogramming of the FY 1990 appropriation?

Mr. Davis. The FY 1990 program funds will be used to continue the existing program as planned and will complete the preliminary and final design of the 165 kWe experiment. The term "close-out activities" was meant to convey that completion of the design effort will be emphasized and that appropriate planning and scheduling would be undertaken such that the design documentation would be completed and experimental equipment maintained into FY 1991 without requiring additional funds in 1991. It is believed that there will be no residual funds nor a funding shortfall and that a request for reprogramming will not be necessary.

Mr. Bevill. What evidence does the Department have to justify its position that sufficient technology has been furnished industry to allow for the commercialization of OTEC?

Mr. Davis. System design models which established conceptual feasibility and operational limits were based on fresh water or simulated

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seawater experiments. Recent DOE supported tests conducted at the Natural Energy Laboratory of Hawaii have provided confirmation of fresh water based hypotheses using water pumped from the sea. This validates concept feasibility and provides the technological basis for evaluation of the commercial potential of the open-cycle concept by industry.

INTERNATIONAL SOLAR PROGRAM

Mr. Bevill. How does the U.S. rank competitively with other countries relative to the development of solar and renewable energy development? Please provide specific dollar allocation by technology in supporting your conclusion.

Mr. Davis. Reliable international funding data is difficult to obtain and, in many cases, even more difficult to analyze on a strict competitive basis. Fiscal periods do not necessarily coincide and may even differ in duration. Areas receiving funds may not correlate on a one-to-one basis. Several foreign government sources may need to be considered, such as support provided by both developmental and export agencies, or direct governmental support augmented by funding from a government owned utility. In such cases, the resultant distilled estimate may be subject to honest disagrement. Against this background, U.S./foreign funding comparisons appear to be bounded by wind, where 6 or 7 foreign nations are estimated to outspend the U.S., and solar thermal, where the U.S. federal outlay exceeds all rivals. All other program areas fall into a middle group where U.S. funding is larger than most other nations. It should be noted that the U.S. is the only nation that is a major player in all important renewable energy areas while most nations select

only one or a few technologies for emphasis. From a technical perspective, the U.S. is among the world's leaders in all renewable technology areas.

SOLAR TECHNOLOGY TRANSFER

Mr. Bevill. Describe your FY 1991 program and indicate the changes from FY 1990.

Mr. Davis. The 1991 technology transfer base program under this line item will be similar to the 1990 program in that it will continue the development of renewable energy information products at SERI, as well as the dissemination of information to the public through the Conservation and Renewable Energy Inquiry and Referral Service. Two new activities are under consideration. We will evaluate the potential for sabbaticals for laboratory personnel, and we will consider the need for developing methods to evaluate the effectiveness of various technology transfer mechanisms.

Mr. Revill. Describe your program to initiate laboratory sabbaticals with industry.

Mr. Davis. We will investigate industry interest and the pros and cons of sending several researchers from our laboratories to spend a sabbatical with companies which are doing research in renewable energy. The program would be patterned after university sabbatical-programs. We also have experience in which researchers from industry have had exchange assignments at SERI or one of the other laboratories performing research on renewables. The

exchange of personnel with industry may have value as a means of first-hand technology transfer.

SERI BUILDING

Mr. Bevill. Please justify your proposal for the construction of a new building at SERI. Please provide the proposed schedule for construction and the estimated total price.

Mr. Davis. The converted leased office buildings that house SERI research laboratories are poorly suited to current research and development activities and have proven difficult and costly to retrofit and maintain. The safety and emergency systems meet only minimum standards. The electric, water, gas, and heating/ventilating/airconditioning systems are strained in meeting daily research needs. The level of floor vibration is too severe to support certain modern instrumentation. Clearly, the scope of research has evolved beyond that which the existing facilities can easily accommodate. If Title I/Title II designs are started in the first quarter of Fiscal Year 1991, construction will begin in the first quarter of Fiscal Year 1992 and will be completed in the fourth quarter of Fiscal Year 1993. The cost estimate, based on the conceptual design, is $19.6 million. This new building will replace the current leased building which houses the photovoltaic and materials research activities.

GEOTHERMAL RESEARCH

Mr. Bevill. Please describe your revised strategy with regard to the Geothermal Program.

Mr. Davis. Geothermal energy can be characterized, according to potential commercial availability, as near-term hydrothermal resources or long-term resources, the latter comprising geopressured, hot dry rock, and magma. The geothermal industry has focused its commercialization and research efforts on hydrothermal resources. In its exploitation of hydrothermal resources, the industry is faced with a number of complex scientific and technical problems including: insufficient knowledge of geothermal reservoirs, extremely expensive drilling technology to deal with the harsh geothermal environment, and lack of efficient energy-conversion technology for low temperature heat sources. The Department's revised strategy is to focus geothermal research efforts on hydrothermal technology in order to assist industry, and to defer research on the longer term technologies. This strategy will encourage cost-sharing by industry and will help industry strengthen its base and improve its international competitiveness.

Mr. Bevill. Justify your expanded program in Hard Rock Penetration.

Mr. Davis. A substantial portion of the cost of generating electric power from geothermal resources is associated with well drilling. Geothermal wells can cost up to four times as much as oil wells because of the more hostile environment encountered -- higher temperatures, harder rock, and more corrosive fluids. Industry has identified the loss of drilling fluid in underpressurized zones as the most urgent problem to be solved in geothermal drilling. The additional funding will be used to accelerate the development of a system for lost circulation control, enabling industry to resolve lost-circulation problems quickly and inexpensively. This technology will include a wellbore hydraulics analysis capability, instrumentation to measure drilling

fluid parameters and a computer-based data acquisition system for real-time use on the rig floor.

Mr. Bevill. Describe your expanded program in reservoir technology and conversion technology.

Mr. Davis. The expanded program in hydrothermal reservoir technology will attack some of the most critical research problems facing the industry. Over 2,000 megawatts of generating capacity are installed at The Geysers geothermal field, but a history of inadequate water injection has resulted in a drying out of the geothermal system. Much of the reservoir technology research will focus on problems at The Geysers. DOE research chemists will develop tracers that will identify the flow paths of steam from injection wells, through the reservoir, to production wells. Working with the industry operators, DOE researchers will then develop and verify a conceptual model for the geothermal reservoir and will use this model to locate injection wells for the most effective pressure maintenance of the field. Joint testing of the most useful injection methods will be used to determine the best operational system for continued energy production from The Geysers. Resolution of production and reservoir management problems at The Geysers will yield advances in reservoir technology that can be applied broadly to other geothermal reservoirs.

In addition to the Geysers-related work, reservoir technology research will continue on basic projects applicable to many types of geothermal reservoirs. In cooperation with industry, DOE-funded scientists will develop reliable computer models that will more accurately predict the energy recovery

and pressure decline for geothermal reservoirs, thereby reducing the major risk facing developers. Continued expansion of geothermal energy development will rely on the effectiveness of exploration methods. Technology in remote sensing and biogeochemistry has been successfully applied to mineral exploration, and these techniques will be adapted and enhanced for geothermal exploration. Geophysical survey methods will be integrated for greater efficiency in discovering geothermal resources. Researchers will examine the technology required for cyclic production of geothermal steam to avoid damage to reservoirs or wells while meeting the needs of utilities for peaking power.

In conversion research, heat cycle experiments will be accelerated and work will begin on the application of research results to a concept for a modular energy conversion system. Researchers also will begin development of a high-temperature drilling mud that can be used to plug lost circulation zones in geothermal wells, and will complete testing of light-weight cements. The effort to create a system for bonding temperature-resistant rubbery materials to steel for downhole equipment will be accelerated. Predictions of scaling by a computer model will be field tested, and the biochemical system to treat geothermal sludges will be tested at the 350-gallon size.

Mr. Bevill. Justify your reduction in the Hot Dry Rock Program.

Mr. Davis. The requested funding for the Hot Dry Rock Program in FY 1991 is approximately the same as FY 1990. The level of funding is consistent with the amount specified by the Department in a report to Congress on the "Long-Term Research Plan for the Hot Dry Rock Fenton Hill Project," dated June 24, 1988. Despite some delays in obtaining suitable equipment for the

ultimate long term flow test of the reservoir at Fenton Hill, the Department will continue its efforts to implement the research plan.

Mr. Bevill. What is the current status of geopressured well activity?

Mr. Davis. At present, two design wells, Pleasant Bayou and Gladys McCall, and one well of opportunity, Hulin, are active. These wells are in various stages of reservoir testing and verification.

Mr. Bevill. What is the status of the Gladys McCall, Hulin and Pleasant Bayou wells? What technical issues remain to be resolved?

Mr. Davis. The Gladys McCall well, south of Lake Charles, Louisiana, is undergoing a long-term pressure buildup test. This test will aid in determining reservoir drive mechanisms and recharge characteristics. The Pleasant Bayou well, south of Houston, Texas, is producing geopressured brine at a rate of 17,000 barrels per day; the DOE/EPRI hybrid power system at the Pleasant Bayou site is operating and supplying electricity into the electric utility grid. These activities will provide information about reservoir longevity and productivity as well as demonstrate the resource's energy conversion potential. One other geopressured well, the Willis Hulin well near Lafayette, Louisiana, has been flow tested recently for a short period and is currently shut in. This well provides the opportunity to learn more about the deeper (>20,000 feet), hotter geopressured resource along the Gulf Coast. The Department's testing program at these wells specifically address the remaining technical issues, which include reservoir recharge, productivity and

longevity, energy extractability and use, and characterization of the deep resource.

Mr. Bevill. What are the primary scientific and technical challenges that remain to be resolved in the development and application of geothermal energy? How is the FY 1991 budget designed to address them?

Mr. Davis. The geothermal industry faces near-term problems of remaining competitive with inexpensive fossil fuels at a time when most of the known high-quality, high-temperature hydrothermal resources have been developed. The Department believes that advanced technology can reduce the costs of geothermal development enough to compensate for the lower thermal quality reservoirs which are much more numerous and widely distributed. DOE's geothermal research, therefore, is aimed at expanding the viable hydrothermal resource base. The FY 1991 budget addresses the technical aspects of what industry has identified as critical areas across the life cycle of a geothermal project: exploration technology, drilling, fluid production and injection, energy conversion, and management of the process chemistry.

Mr. Bevill. Please describe your priorities for the Geothermal Program, and the relative merits and weaknesses of the competing technologies and projects.

Mr. Davis. The highest priority for the Geothermal Program is to support research and development on those hydrothermal problems that will allow the geothermal industry to contribute more fully to our nation's energy supply. Specific projects are selected carefully based on their probability

of technical success and their pertinence to industry needs. The program interacts regularly with the geothermal industry on program priorities and involves industry in cooperative research and technology transfer. As a result of these interactions, the highest research priorities have been assigned to the improvement of reservoir, hard rock penetration, and energy conversion technologies.

Of the competing geothermal technologies, hydrothermal is the only one being used today commercially, with over 2,750 MWe of installed electrical capacity in the United States, and over 17 trillion BTU's per year being used for direct use purposes, such as space heating, greenhouses, aquaculture, and geothermal heat pumps. The merits of hydrothermal energy are that it is a relatively clean, safe resource, which can be used to generate electricity in a base-load or load-following mode with availability factors of over 95%. The weakness of hydrothermal technology is that today's technology can be used economically only for the Nation's highest grade resources, essentially those resources with temperatures above 150°C. Additional research will be needed to enable industry to exploit the larger, lower grade resources.

Of the remaining geothermal technologies, which include geopressured, hot dry rock, and magma, all will require the extensive development of advanced and sophisticated technology before industry will assume the risk of commercialization. The merits of the geopressured resource are two-fold: first, geopressured fluids can provide three forms of energy -- chemical energy from dissolved methane, thermal energy from high temperatures, and hydraulic energy from high pressures (up to 18,000 psi); secondly, the methane gas contained in geopressured reservoirs represents a large source of

unconventional natural gas. The merits of magma and hot dry rock resources lie in the fact that they represent a larger resource, and are more broadly distributed than hydrothermal resources. Moreover, their higher temperatures -- up to 1,200°C -- provide higher thermal efficiencies. However, because of more severe operating conditions including high temperatures, harder rock, and greater depths, they will be much more difficult to exploit.

HYDROPOWER INITIATIVE

Mr. Bevill. Describe and justify your proposed initiative in hydropower research.

Mr. Davis. Testimony at recent hearings on the National Energy Strategy has identified three major factors which are currently restricting hydropower's contribution to the national energy mix: first, the lack of a single focus for final decisions regarding hydropower development and regulation; second, a time-consuming, costly, disorganized, licensing/permitting process largely due to the duplicative environmental review process with overlapping layers of jurisdiction; and, third, a need for specific R&D with regard to environmental assessment methods. Regulatory and institutional reforms appear to be essential to the further development of hydropower. The NES testimony has identified a number of regulatory issues and potential reforms. The Department in cooperation with other resource and regulatory agencies must now critically review, analyze and prioritize these issues and reform options to determine those areas where progress is possible that allows for additional hydropower development while providing acceptable environmental protection.

ELECTRIC ENERGY SYSTEMS BIOLOGICAL EFFECTS

Mr. Bevill. Describe your research program on the biological effects and risks of exposure to high-voltage electric and magnetic fields. Justify your proposed reduction.

Mr. Davis. For the last decade, the Office of Energy Storage and Distribution has funded studies on the interaction between electromagnetic (EM) fields and biological systems. A number of effects from EM fields were shown to be transient and without apparent health impacts. However, other effects such as altered circadian (daily) rhythms and changes in hormonal balance were seen to depend on more fundamental interactions on the cellular level. Behavior of exposed animals as well as important endocrinological factors will be closely monitored. An essential problem for EM exposure is the absence of a simple dose/effect relationship. Unlike ionizing radiation, which can disrupt molecular bonds, EM fields do not affect the cellular nucleus directly. Unlike microwaves, they do not have enough energy to affect the entire cell thermally. It appears, instead, that EM fields interact with the membrane of the cell surface. Because the cell membrane controls all messages into and out of the cell, any changes to it may be of crucial importance. The exact nature of the field/membrane interaction is as yet little understood. Because it is non-linear, it appears to be of considerable complexity and does not lead to the simple dose effect relationship observed for many toxic substances.

Much further work will be required to complete a scientific data base which can accurately determine potential public health hazards. DOE believes that the FY 1991 request of $2.5 million is adequate to continue key research involving the interactions between EM fields and biological systems.

HIGH TEMPERATURE SUPERCONDUCTIVITY

Mr. Bevill. Please provide specific examples of the application of high-temperature superconducting technology to electric energy generation, transmission and storage.

Mr. Davis. Motors, generators, transformers, underground transmission lines and magnetic energy storage units all can utilize high-temperature superconducting materials. Scientific feasibility has been established, but practical requirements for these applications cannot be met until researchers can achieve high current in magnetic fields, good mechanical properties for ease of fabrication and durability, and chemical stability for long life without degradation. There are presently no large-scale electric generation, transmission or storage systems in operation or under development which utilize high-temperature materials. The DOE Electric Energy Systems research program is focused on the development of high-temperature superconducting technology for a wide spectrum of applications.

Mr. Bevill. Please describe the FY 1990 and FY 1991 high-temperature superconducting material research program.

Mr. Davis. The Electric Energy Systems program on high-temperature superconductivity has two important thrusts: to speed up the process of moving high-temperature superconductivity from the research laboratory to the marketplace through Superconductivity Pilot Centers and to conduct research and development on high-temperature superconductivity technology for large-scale electric power applications. The three pilot centers at Argonne National Laboratory (IL), Oak Ridge National Laboratory (TN), and Los Alamos National Laboratory (NM) were created in October 1988 to help establish partnerships with industry to accelerate the development of high-temperature superconducting technology in the United States. Currently twenty-four collaborative agreements pairing laboratories with private firms have been signed which cover a broad range of topics including magnetic bearings, thin film electronics, conductors from bulk materials and a small electric motor. In FY 1989, Electric Energy Systems funding for the Pilot Centers was $4.5 million to initiate activities, and in FY 1990, continued at $6 million. In FY 1991, the President's budget will expand the Pilot Center funding to about $15 million to include more industry participants. DOE's Electric Energy Systems program on Superconducting Technology for Electric Power Systems (STEPS) develops technology for large-scale applications requiring high current in magnetic fields. This applied research will provide a technology base for industry to develop a wide range of potential commercial products including motors, generators, transmission lines and energy storage magnets. The focus of the STEPS program in both FY 1990 and FY 1991 is the development of processing techniques and fabrication of practical high-temperature superconducting conductors from either bulk materials or thin films. In FY 1990 and FY 1991 funding of about $6 million is provided for the STEPS program, which includes subcontracts to university and private companies for

cooperative research participation as well as a solicitation for industry design of compact Superconducting Magnetic Energy Storage (SMES) systems.

Mr. Bevill. Describe how the high-temperature superconducting program is coordinated within the Department.

Mr. Davis. Coordination of high-temperature superconductivity programs within the Department of Energy is done through the Energy Materials Coordination Committee (EMaCC), Subcommittee on Superconductivity. An annual report of DOE superconductivity research is prepared and distributed throughout the Department. In addition, there are frequent meetings and exchanges of information between DOE program staffs.

ELECTRIC ENERGY SYSTEMS RELIABILITY R&D

Mr. Bevill. What work remains to be done on reliability R&D in the electric energy systems program and what is the Federal role in this work?

Mr. Davis. The Federal role in reliability R&D is to develop new technology and techniques to improve transmission lines availability, respond to future load growth, and integrate electricity from renewable energy sources and independent power producers into the grid while maintaining overall system reliability. The research is coordinated with other Federal agencies and industry. The Electric Energy Systems program is currently focused on advanced system controls and protection concepts, real time data and analyses to automate networks, impacts of harmonics on electrical equipment, fiber optic applications for sensing and communicating, and methods for on-line

detection of systems instabilities. Successful completion of these projects will allow utilities to continue operating reliably with lower reserve margins, mitigate emergency situations, and accommodate expected changes in the future electric generation and transmission industries.

ENERGY STORAGE BATTERY DEVELOPMENT

Mr. Bevill. Describe the Department's Battery Development program through 1990 and describe your shift in priorities.

Mr. Davis. Sodium sulfur, zinc bromine, and aluminum air battery technologies are being developed through cost-shared industrial contracts. The development of a small sodium sulfur cell for electric vehicle application will be successfully completed in FY 1990 with the transer of this technology to the Office of Transportation Systems and to industry. The Office of Energy Storage and Distribution will continue the core technology development of larger sodium sulfur cells and batteries through FY 1991. The zinc-bromine battery exploratory development for stationary applications will also continue through FY 1991.

The FY 1991 budget submission reflects the decision to focus on the development of the Proton Exchange Membrane (PEM) fuel cell. Very significant progress has been made in achieving reduced cost and improved power performance making the PEM a very attractive option. Increased efforts will also be directed toward the development of high performance air cathodes for fuel cells and metal air batteries.

Mr. Bevill. Please describe the status of the aluminum-air and zinc-air battery system.

Mr. Davis. Aluminum-air battery technology has been commercialized as a primary battery system for several highly specialized telecommunication and military applications. As a rechargeable battery system, aluminum-air batteries may be used as a principal power system or a range extender for electric vehicles. An advantage of aluminum-air battery systems is high energy density, which allows a vehicle using this battery to have a long range. The disadvantages are system complexity, low efficiency, and lack of infrastructure to service the battery. Good progress has been made on an advanced cell design. The range with this new design is estimated to be 350 miles. In addition, this new system appears to require about 1/3 the volume of prior designs.

Zinc-air batteries are another promising battery option for use in electric vehicles. Currently, zinc-air primary batteries are used for hearing aids and remote applications. The air cathode used in these systems is a spin-off of a DOE development. DOE is exploring new concepts to produce a high-performance, low-cost zinc-air system.

SEASONAL ENERGY STORAGE PROGRAM

Mr. Bevill. Describe the status of the Seasonal Energy Storage Program.

Mr. Davis. The Seasonal Energy Storage program is focused on the development of the heat and chill aquifer technology at two field test

facilities in Alabama and Minnesota. Currently, a long-term test cycle, third in a series, is being performed at the heat Aquifer Thermal Energy Storage (ATES) test facility, St. Paul, MN, to analyze integrated energy management and recovery for actual building use. Modeling and field monitoring is being conducted cooperatively and cost-shared among the University of Minnesota, DOE, and the U.S. Geological Survey. Preliminary findings support continued non-federally sponsored operation by the University of the installed test system and additional ATES systems for other campus buildings. Building cooling requirements of the University of Alabama Student Recreation Center have been satisfied by the chill ATES system for the past five calendar years. Implementation of the ATES system reduced consumption of electrical energy by 50 percent. Valuable insights have been gained which should make it possible to improve system performance even further. Monitoring of energy consumption and recovery and microbiological behavior will be completed this year. Based on this database, plans to co-fund field verification testing at the General Motors Harrison Radiator Plant in Tuscaloosa, AL, will be established to initiate a chill ATES field test for an industrial operating cycle at an acceptable cost. The development of mathematical models for simulation of ATES systems will continue. These predictive tools are necessary for site evaluation and design of ATES systems. The primary product of this modeling task will be computer programs suitable for general use by architect/engineer design groups.

THERMAL ENERGY STORAGE

Mr. Bevill. In a 1988 study, a Blue Ribbon Panel from the American Society of Mechanical Engineers determined that the Department of Energy's

program in Thermal Energy Storage has had a "very substantial contribution," is being "well run," and is "highly deserving of continued support" at a recommended budget level of $5 million annually. Why then does the Department of Energy propose to reduce the funding to $1 million in FY91 and eliminate this program in FY92?

Mr. Davis. The Department's research and development programs have been successful in establishing the basic technology for both diurnal and seasonal thermal storage. Field tests have established their feasibility. What remains under development are the mathematical models that allow prediction of aquifer system performance across the range of potential application sites. The development of these models will continue with FY 1990 funding and the proposed FY 1991 budget. Departmental deliberations on the FY 1992 budget are just now getting underway.

Mr. Bevill. Given the fact that studies show that thermal energy storage can reduce energy consumption by between 2 and 4 quads and reduce CO_2 production by between 100 and 200 million tons per year, why has the funding for this program been reduced from $7 million in FY86 to $1 million in FY91 with program close out proposed for FY92?

Mr. Davis. The Department will have completed the development of basic thermal storage technology by the end of FY 1991. This development has been undertaken in cooperation with industry and includes verification in full-scale test sites. At that point, the technology should be ready for private sector commercialization.

Mr. Bevill. Why has DOE been unable to fund the continued development of advanced thermal energy storage technologies, such as composite phase change materials, allowing these technologies, originally developed in the U.S. with DOE funds, to be commercialized by foreign countries and sold back to the United States?

Mr. Davis. Advanced thermal energy storage technologies, such as composite phase change systems, have been supported by the Department for some time. They have been available for commercial deployment but have not attracted industry interest in the United States. It is not uncommon that industries in other countries with more acute energy problems will adopt particular technologies earlier than domestic industries.

Mr. Bevill. Investigations have continued to show the value of thermal energy storage for improving energy efficiency, reducing environmental degradation, and increasing cost competitiveness in the industrial, utility, and buildings sectors. Why has the Department of Energy continued to propose elimination of much needed research in this vital area?

Mr. Davis. Thermal energy storage technologies have been shown to be feasible through the Department's development program. Implementation by industry is the next step required for their widespread use.

ENVIRONMENT, SAFETY AND HEALTH PROGRAM

Mr. Bevill. The Committee is pleased to see the Administration provide support for the Environment, Safety and Health program.

I am concerned, however, that your initiatives are proposed to begin in FY 1990 and the Department has not sought the approval of Congress to change from the way the funds were appropriated.

The Committee has worked well with the Department in the past, but I want to make it very clear that the funds are to be used for the purposes appropriated unless a reprogramming has been proposed and accepted.

I would like your assurance that you will not divert the funds appropriated without an approved reprogramming.

Mr. Brush. Mr. Chairman, I can assure you that the funds appropriated to Environment, Safety and Health are being used for the purposes appropriated. The Department has initiated several organizational changes that result in Environment, Safety and Health responsibilities being transferred to other Departmental organizations. Thus, the funds may be spent by another organization within DOE, but they will be used for the purposes appropriated.

We appreciate the support of the Committee in the past and I will undertake to keep the Committee informed of these organizational changes.

Mr. Bevill. Please describe the significant restructuring and reorganizing of the Environment, Safety and Health programs in FY 1991.

Mr. Brush. The Secretary's management reforms, Ten Point Plan and several other initiatives, coupled with the establishment of the Defense Nuclear Facilities Safety Board and the continued support of the Advisory Committee on Nuclear Facility Safety, have resulted in some changes in the responsibilities of the Office of Environment, Safety and Health. Responsibility for nuclear reactor and non-reactor nuclear safety policy has been transferred to the Assistant Secretary for Nuclear Energy. In accordance with the establishment of line responsibility, the Assistant Secret for Defense Programs, the Assistant Secretary for Nuclear Energy, and the Director of the Office of Environmental Restoration and Waste Management are responsible for the safe operation of all facilities under their jurisdiction. The Director of the Office of New Production Reactors has line responsibility the design and construction of new production reactors. Independent internal nuclear facility safety oversight is provided by the new Office of Nuclear Safety. Independent external nuclear facility safety is provided by the new Defense Nuclear Facilities Safety Board, and the Advisory Committee on Nuclear Facility Safety. The Office of Environment, Safety and Health will continue t perform oversight in the areas of environmental protection, radiation safety, worker safety, non-nuclear facility safety, emergency preparedness, and those aspects of public health and safety that deal with epidemiology and radiologic protection at DOE facilities. This applies both to defense and non-defense facilities.

In addition, the Office of Policy, Planning and Analysis, through Departmental reorganization, has acquired the leadership role for environmental analysis of national and international environmental issues that affect U.S. energy supply, demand and prices. This includes for example, analysis of legislative and regulatory change at the national level and global climate change at the international level.

Also, as part of the Secretary's organization and management reforms, in the very near future the Assistant Secretary for Environment, Safety and Health will be assuming responsibility for inspecting and assessing the effectiveness of the Department's safeguards and security policies, programs, and implementation in the field, and for the safety certification of packages for shipment of DOE radioactive materials. This program is currently in the Office of Defense Programs and is therefore covered in Defense Programs' FY 1991 budget request.

FACILITY OPERATOR TRAINING AND ASSISTANCE

Mr. Bevill. Please describe the Facility Operator Training and Assistance program and justify the location of this effort in the Office of Environment, Safety and Health.

Mr. Brush. It is the consensus of both external safety reviews of DOE operations and internal ES&H safety appraisals that a more consistent, interactive, and vigorous DOE program of training for personnel responsible for the conduct of operations at DOE facilities is necessary. The DOE recently issued a training accreditation Order that will begin to forge this

process. However, for the purposes of promoting uniformity among training programs in terms of content, approach, and personnel required to be trained, ES&H initiated the Facility Operator Training and Assistance Program (FOTAP) in FY 1990 and proposes to strengthen the FOTAP in FY 1991 for problematic technical areas that ES&H has independent internal oversight responsibility. The technical areas of greatest concern are radiation protection of DOE and operating contractor workers and DOE compliance with the Occupational Safety and Health Act (OSHA).

Over the past year, DOE has strengthened efforts to comply with OSHA requirements in response to the Secretary's initiatives. In doing so, nearly 1000 instances of noncompliance with OSHA requirements were found at the Y-12, Mound and Pantex facilities alone. A root cause for the number and type of noncompliances is insufficient training of workers, line managers and safety professionals. A cooperative training program between ES&H and the Occupational Safety and Health Administration is currently in the development stages and is designed to create a cadre of DOE and operating contractor safety and health professionals in FY 1991. OSHA will help ES&H conduct this training. After the testing phase is completed, the conduct of the training program will be expanded by the end of FY 1991 to: (1) reach all appropriate operating contractor and DOE safety oversight professionals on a continuing basis, and (2) provide training for operating contractor workers and DOE line managers. This training will help ensure that safety professionals are competent with regard to OSHA requirements and good practices.

In the radiation safety area, two problems continue to perpetuate inadequate worker protection across the DOE complex. These are: (1) inadequate and nonuniform training content and requirements, and (2) lack of qualified radiation protection scientists and engineers. In FY 1990, ES&H initiated the development of a generic DOE occupational worker and radiation worker training manual for use by operating contractors and DOE staff. Effective use of this manual will provide a foundation upon which more sophisticated training can be built, tailored to individual DOE site or facility operational needs. In FY 1991, ES&H plans to provide assistance to line programs and operating contractors to upgrade their site specific training development program. In addition, ES&H plans to develop detailed lesson and training aide plans which describe the details and content of Headquarters approved radiation protection training in those specialized work activities that our appraisals have indicated need improvement, e.g., plutonium health physics, reactor health physics, and calibration laboratory operations.

To address the lack of adequate numbers of qualified radiation protection scientists and engineers in the DOE complex, ES&H initiated a Health Physics Fellowship Program in FY 1990. The purpose of the Program is to provide continuing education for college graduates in the area of radiation safety who will also work at DOE facilities to obtain "hands-on" training. Successful graduates of this program will be offered job opportunities either at the site of their training or another one. This program will introduce radiation safety professionals to DOE-type operations and make them more valuable employees immediately upon completion of their studies. Currently, ES&H has 13 universities and 20 students participating

in the program. In March, 1990 an additional 20 graduates will be selected to participate. The Department plans to use $750,000 in FY 1990 to fund this program. The proposed budget for FY 1991 is $850,000.

In summary, ES&H is developing training programs for the OSHA and radiation protection areas and is conducting training in OSHA requirements and good practices.

NUCLEAR SAFETY

Mr. Bevill. Please identify by appropriation, organization, and at the budget level of detail, all funding provided in FY 1990 and FY 1991 for nuclear safety activities throughout the Department.

Mr. Brush. The Department is currently preparing the nuclear safety activity crosscut. I will be happy to provide that crosscut as soon as it is finished.

Mr. Bevill. Please justify the placement of the Nuclear Safety Office in the Office of the Secretary.

Mr. Brush. The safe operation of the Department's nuclear facilities is one of Secretary Watkins' highest priorities. In order to improve the Department's nuclear safety performance, the Secretary instituted a number of management changes including direct line management responsibility and accountability and new self-assessment functions within Defense Programs, Nuclear Energy, Environmental Restoration and Waste Management, and the New Production Reactors Program. Because of the high priority the Secretary

places on nuclear facility safety, the Secretary formed a separate Office of Nuclear Safety to advise him of whether line management and its self-assessment functions are adequately assuring nuclear safety.

Mr. Bevill. Please describe the role of the Office of Nuclear Safety. Please describe any change in the role of the Office of Nuclear Safety.

Mr. Brush. The new Office of Nuclear Safety has broad responsibilities to monitor and audit all aspects of nuclear facility safety, including field office and contractor performance, through review of documentation such as Technical Safety Appraisal, Safety Analysis Reports, and program office and site reports, as well as observing on-site activities. This office is responsible for identifying to the Secretary special circumstances that are indicative of deteriorating or poor performance that may warrant further in-depth appraisals. Also, the Office of Nuclear Safety will review and concur in Departmental poiicies for nuclear facility safety, and will carry out enforcement activities associated with the civil and criminal penalty authority of the Price-Anderson Amendments Act.

Mr. Bevill. What is the rationale for the movement of the Office of Nuclear Safety from Environment, Safety and Health?

Mr. Brush. The Department's new independent internal oversight system provides means for both Program Secretarial Officers and the Office of the Secretary to verify independently that the expected level of nuclear facility safety performance is being achieved. The creation of the Office of Nuclear Safety has elevated this function so that it now reports directly

to the Secretary. The Office of Environment, Safety and Health remains responsible for independent internal oversight of all other aspects of safety. This allows the Department to consolidate limited resources in the field of nuclear facility safety and the Office of Environment, Safety and Health to concentrate on other high priority activities such as the "Tiger Team" Compliance Assessments and establishment of a strong OSHA-type worker safety program.

Mr. Bevill. Please describe the self-assessment role of nuclear safety compliance in the Office of Assistant Secretary for Nuclear Energy and the Assistant Secretary for Defense Programs.

Mr. Brush. Nuclear Self-Assessment offices are being established within Office of the Assistant Secretary for Nuclear Energy, the Office of the Assist Secretary for Defense Programs, and the Office of Environmental Restoration an Waste Management. The Nuclear Self-Assessment Offices report directly to the Program Secretarial Officer and perform design, construction and operational evaluations of nuclear facility safety independent of line offices with programmatic responsibilities. These offices will provide a separate check, o sample basis, the nuclear safety performance being achieved and will not have production responsibilities.

Mr. Bevill. Please describe the relationship between the old role of Environment, Safety and Health with regard to Nuclear Safety and the Office of Nuclear Safety reporting to the Secretary; the nuclear safety policy functions of the Assistant Secretary for Nuclear and the nuclear self-

assessment roles of the Assistant Secretary for Nuclear Energy and the Assistant Secretary for Defense Programs.

Mr. Brush. The Department's management structure for assuring nuclear safety was simply not working, as evidenced by the recurrence of problems and deficiencies dating back to DOE studies performed in the aftermath of the Three Mile Island accident. Periodic oversight by the Office of Environment, Safety and Health and other external oversight bodies was not sufficient to ensure safety. For this reason, the Secretary instituted a new system for nuclear safety similar to that which has proven effective for over 35 years in the U.S. Navy and in the commercial nuclear reactor industry since Three Mile Island. The new system provides for direct line responsibility for carrying out day-to-day, shift-by-shift oversight, self-assessment offices giving line management a means to check their own nuclear safety performance; and the new Office of Nuclear Safety giving the Office of the Secretary a means to verify independently that the expected level of nuclear safety performance is being achieved and to ensure consistency across the program offices. The assignment of responsibility to the Assistant Secretary for Nuclear Energy for developing and coordinating Departmental policy on nuclear facility safety allows for consolidation of limited resources in the nuclear field. Policies developed by Nuclear Energy are subject to the review and concurrence of the Office of Nuclear Safety. The Office of Environment, Safety and Health will be able to concentrate its efforts on other high priority oversight responsibilities in the environment, safety and health areas.

Mr. Bevill. Please justify how the changes in Nuclear Safety contribute to direct-line management.

Mr. Brush. Nuclear facility safety encompasses all systems and activities that can influence the potential for uncontrolled release of fission products, or for nuclear criticality. Assurance of nuclear facility safety involves not only verification that nuclear reactor and non-reactor nuclear facility designs comply with applicable standards, but also verification that plant modifications, operations, maintenance, and plant material conditions meet nuclear facility safety requirements and that human performance aspects which could potentially affect nuclear facility safety are receiving appropriate attention.

Line management must be held wholly accountable for nuclear safety and must develop and maintain the necessary technical capability to carry out its responsibilities. Only stronger line management -- no matter how much oversight is added -- will ultimately solve the problems in the operations of the Department. Holding line management responsible for the safety of their facilities, and instilling in them the right attitudes toward safety and toward critical self-assessment, is one of the primary and immediate priorities of the Secretary. The new Office of Nuclear Safety will oversee line management and its self-assessment functions to ensure that each of the line programs is adequately assuring nuclear facility safety. The Office of Nuclear Safety will conduct performance assessments of the field and program offices. Information provided by the Office of Nuclear Safety will be used by the Secretary to give direction to the Program Assistant Secretaries who,

under the Department's line management organization, are accountable for the safe operation of all facilities under their jurisdiction.

Mr. Bevill. Please justify the movement of the security oversight review from the Assistant Secretary for Defense Programs to the Environment, Safety and Health.

Mr. Brush. The Office of Security Evaluations performs an internal independent oversight function that is compatible organizationally with the internal oversight functions of the Office of Environment, Safety and Health.

Mr. Bevill. Please provide the rationale for the movement of nuclear safety oversight out of Environment, Safety and Health and the movement of security oversight into Environment, Safety and Health.

Mr. Brush. As I stated previously, the Office of Security Evaluations performs an internal independent oversight function that is compatible organizationally with the internal oversight functions of the Office of Environment, Safety and Health. Under the Department's new management structure for assuring nuclear safety, the new Office of Nuclear Safety was established to give the Office of the Secretary a means to verify independently that the expected level of nuclear safety performance is being achieved and to ensure consistency across the program offices.

Mr. Bevill. Please provide the rationale for the transfer of the Environmental Analysis function from Environment, Safety and Health to Policy.

Mr. Brush. There were three reasons for this transfer. First, at the President's direction, the Secretary has initiated the development of an integrated National Energy Strategy that places energy, health, safety, environment, technology, and economy into a mutually supportive framework. The Secretary has established a coordinated planning, programming and budget capability that can integrate horizontally the findings of the National Energy Strategy across the entire range of DOE programs in order to bring plans and programs into line with near, mid and long-term objectives with the Strategy. Organizational responsibility has been assigned to the newly-strengthened office of Policy, Planning and Analysis. The Environmental Analysis Program, which is responsible for analyzing significant environmental issues that affect national energy supply, demand and prices, is an essential organizational element that supports this program.

Second, the Department will play a major role in developing and implementing energy responses to potential global change. Responsibility for developing global climate change policy lies with the Office of Policy, Planning and Analysis where the Office of Environmental Analysis' functions provide direct support.

Third, the analysis and Departmental response coordination of the energy industry effects of legislative and regulatory change are best

carried out by the Policy Office -- rather than my office with our emphasis on the activities of the Department's facilities.

Mr. Bevill. Please describe the training programs in your various budget activities.

Mr. Brush. The Office of Environment, Safety and Health manages a number of training problems for DOE line management and staff, as well as contractor staff, in the areas of environmental regulations, requirements and compliance procedures; safety procedures and techniques; appraisal/audit procedures and techniques; and the sponsorship of a fellowship program in the area of health physics.

TIGER TEAMS

Mr. Bevill. Please describe the Department's program of Tiger Teams.

Mr. Brush. On June 27, 1989, the Secretary of Energy announced a Ten-Point Plan to strengthen safety, environmental protection, and waste management activities at DOE's production, research, and testing facilities. The Initiative is part of the Secretary's overall plan to assure full accountability in the areas of environment, safety, and health, and ensure that all DOE facilities achieve and maintain full compliance with Federal, state, local, and Departmental environment, safety and health requirements.

As part of the Ten-Point Plan, the Secretary initiated independent "Tiger Team" Compliance Assessments to assure compliance with these

requirements. The "Tiger Team" Compliance Assessments are among the Department's highest priorities and form the cornerstone of DOE's overall plan to create a new culture of self-assessment and accountability. These assessments are essential to bringing all of the Department's facilities into full compliance with environment, safety and health requirements.

The purpose of the "Tiger Team" Compliance Assessment Program is to provide the Secretary of Energy with concise information on the current environment, safety and health compliance status of each facility and associated vulnerabilities; root causes for noncompliance; adequacy of DOE and site contractor environment, safety and health management programs; response actions to address identified problem areas; and DOE-wide environment, safety and health compliance trends and root causes.

Mr. Bevill. Please describe the number and funding of Tiger Teams used in FY 1989, FY 1990 and FY 1991.

Mr. Brush. The "Tiger Team" Compliance Assessments are comprised of three components - an environmental component, a safety and health component, and a management and organization component. The environmental component is funded under the Environmental Audit Program and the NEPA Project Assistance Program, both of which were appropriated funds for conducting environmental compliance assessments and reviews. The safety and health component is funded under the Safety Appraisals Program and Quality Programs, both of which also were appropriated funds for safety and health

oversight appraisals and reviews. The management and organizational component is conducted using federal employees.

In FY 1989, "Tiger Team" Compliance Assessments were conducted at 4 facilities at a total cost of $1.6 million. In FY 1990, "Tiger Team" Compliance Assessments will be conducted at 13 facilities, at an estimated total cost of $12.8 million, exclusive of sampling and analysis. In FY 1991, we are proposing to perform "Tiger Team" Compliance Assessments at 12 facilities, at an estimated total cost of $12.3 million, exclusive of sampling and analysis.

Mr. Bevill. Please describe the role, funding and typical size and charter of a Tiger Team.

Mr. Brush. "Tiger Team" Compliance Assessments will be conducted at major DOE operating facilities. Each "Tiger Team" will be organized to conduct assessments of environment, safety and health, and management and organization activities. These three assessment components, which comprise the overall "Tiger Team" Compliance Assessment, are fundamental to the organization, procedures, and documentation to be produced by the "Tiger Teams". The assessments will include, but not be limited to, compliance with applicable Federal, state and local regulations, permit requirements, agreements, orders and consent decrees; compliance with DOE Order requirements for environment, safety and health activities; adequacy of DOE and site contractor ES&H management programs, including planning, organization, resources, training, and relationship with regulatory agencies; conformance with applicable "best" and "accepted" industry

practices; identification of root causes; and identification of noteworthy practices. Conducting a "Tiger Team" Compliance Assessment typically requires more than 30 highly skilled and experienced professionals, and could potentially involve four to six weeks of onsite activities as well as three to four weeks of preparation and follow-up activities. The average cost of a "Tiger Team" Compliance Assessment is about $900,000 exclusive of sampling and analysis.

Mr. Bevill. Please justify the transfer of the national emergency response capability to Defense Programs.

Mr. Brush. The Office of Environment, Safety and Health currently manages the Atmospheric Release Advisory Capability and Aerial Measuring Systems programs. These programs are important elements of the Department's national emergency response capability and serve both the commercial and defense sectors in the United States. Defense Programs currently manages the majority of resources associated with emergency preparedness for defense-related purposes. Therefore, the capabilities exist such that the programs can be assumed by Defense Programs. Consolidating the Atmospheric Release Advisory Capability and Aerial Measuring Systems programs with Defense Programs' emergency preparedness program should facilitate and improve planning, budgeting and program execution.

Mr. Bevill. Please describe the Department's role in reviewing the impact of revised Price-Anderson legislation.

Mr. Brush. The Price-Anderson Amendments Act requires that the Department put in place a program of prescribed requirements including fines and penalties, both civil and criminal, and an enforcement mechanism. The Department is in the process of doing this under the new Office of Nuclear Safety. Rulemaking to establish these functions will be published in the Federal Register in the next few months.

PLANNING AND INFORMATION RESOURCES MANAGEMENT

Mr. Bevill. Please justify the increase in Planning and Information Resources Management.

Mr. Brush. The increase of $360 thousand is requested to support those unanticipated planning activities that for the past 3 or 4 years have always come up. For example, EH was assigned responsibility in 1987 and 1988 to prepare responses to two National Academy of Sciences reports. Also in 1988, EH was assigned responsibility for preparing the Department of Energy's Environment, Safety and Health Needs Assessment. These three examples were major undertakings that were unplanned and had not been budgeted for.

Mr. Bevill. Please describe the facilities and equipment involved in the Planning and Information Resources Management effort.

Mr. Brush. The majority of ES&H information collected under the Planning and Information Resources Management activity resides on a DOE-owned computer at the Idaho National Engineering Laboratory in Idaho Falls,

Idaho. The computer is a Hewlett Packard 3000, model 950, and is operated for DOE by EG&G Idaho, Inc. Data storage is provided on six 404-MB fixed media disks and two 571-MB fixed media disks. DOE Headquarters users may access this computer over a dedicated line between the Germantown office and the Idaho National Engineering Laboratory which provides 9600 baud service through 12 ports. Field users may access the computer via Tymnet or FTS lines through any of 60 ports at any baud rate up to 9600 supported by the user's equipment. Most of the 400-plus users access the computer with an IBM-compatible personal computer using a communications software package which emulates a block mode terminal.

The primary program on the computer is referred to as the Safety Performance Measurement System. The Safety Performance Measurement System is actually a set of interfaced subsystems which are used for the collection, storage and analysis of safety-related accidents and occurrences, tracking, and dissemination of all types of environmental, safety and health information regarding policy, guidance, standards, technical issues, and current events of environmental, safety and health significance. Thus, while the primary function of the Safety Performance Measurement System is to support evaluation and analytical efforts aimed at reducing risk from DOE operations, it also complements conventional communications by providing a centralized resource for rapid, free, and open access to environmental, safety and health information needed by anyone in the DOE community.

NATIONAL LABORATORIES

Mr. Bevill. Please estimate the amount of the FY 1989, FY 1990 and FY 1991 program that will go to the national laboratories. Please provide this information by laboratory.

Mr. Brush. I will provide the information as an insert in the record. (The information follows:)

LABORATORY FUNDING
(dollars in thousands)

Laboratory	FY 1989	FY 1990	FY 1991
Lawrence Berkeley Laboratory	$ --	$ 325	$ 375
Lawrence Livermore Laboratory	3,185	2,390	1,150
Idaho National Engineering Lab.	14,489	17,055	9,640
Argonne National Laboratory	5,342	4,800	5,705
Los Alamos Scientific Laboratory	1,356	2,900	2,750
Brookhaven National Laboratory	3,850	2,570	2,420
Oak Ridge National Laboratory	7,882	4,467	5,395
Pacific Northwest Laboratory	9,524	11,675	10,161
	$45,628	$46,182	$37,596

It should be noted that the apparent reduction in FY 1991 funding for the national laboratories is likely due to the fact that our FY 1991 budget implementation plans are in the formative stage.

Mr. Bevill. Please describe the role of the Medical Director and justify why that responsibility should be under Environment, Safety and Health.

Mr. Brush. As the Committee is well aware, the Department of Energy operates many complex facilities requiring constant monitoring to assure that the safety and occupational health of DOE contractor employees is

protected from operational hazards. The Department has one of the largest occupational medicine programs in the world, comprised of 48 contractor occupational medical departments located at DOE facilities, and employing 120 occupational physicians and some 2,000 ancillary occupational health specialists. The Medical Director has Departmental responsibility for providing occupational medicine program oversight for all DOE government-owned contractor-operated facilities and assuring that DOE contractor employees at these facilities are provided medical care within Department standards.

Mr. Bevill. Describe the contractor incident reporting system developed by Environment, Safety and Health.

Mr. Brush. The Secretary has directed that the incident reporting system be completely overhauled. In a variety of environment, health, safety and security-related situations over the past year, reports available to top DOE management did not reflect actual situations which prevailed in the field. As a consequence, neither preventive nor corrective actions were instituted in a timely fashion. Crisis management, after the fact, had become the norm. An entirely new system of reporting, analysis, and follow-up is being instituted to help minimize unwarranted surprises and maximize operational effectiveness.

Mr. Bevill. Why is this the responsibility of Environment, Safety and Health?

Mr. Brush. As part of the Secretary's management and organizational reforms, this responsibility has been transferred to the Assistant Secretary for Nuclear Energy.

Mr. Bevill. What is the total Department funds on environment and safety work funded by the various programs for FY 1989, FY 1990 and FY 1991?

Mr. Brush. The Department's funding in FY 1989, FY 1990 and FY 1991 for environment, safety and health activities is $2,828.0 million, $3,698.5 million and $4,523.0 million respectively.

Mr. Bevill. How does the budget for Environment, Health and Safety compare as a percentage of the total Department funds for Environment, Safety and Health by year?

Mr. Brush. The budget for the Office of Environment, Safety and Health represents 3 percent in FY 1989, 3 percent in FY 1990 and 2 percent in FY 1991 of the total Department funds for environment, safety and health.

Liquefied Gaseous Fuels Spill Test Facility

Mr. Bevill: Please provide a list of all tests performed at the Liquefied Gaseous Fuels Spill Test Facility in FY 1989, FY 1990 and proposed for FY 1991. This should include a brief description and purpose of the test, other participants, total cost of the test allocated by participant, reimbursements received for the test, and results or conclusions of the test.

Mr. Gentile: The following list provides a brief description, purpose of the test, other participants, total cost allocated by participant, reimbursements received, and the results or conclusions for all tests performed in FY 1989 and FY 1990, and those proposed for FY 1991.

1989 TEST SEASON

Three scheduled test series were postponed during the 1989 test window due to environmental concerns regarding the Desert Tortoise, an endangered species. The Tortoise issue, i.e. habitat extent, chemical effect, lethality, etc., were thoroughly re-examined by the Department of the Interior, Fish and Wildlife Service (FWS) in light of tests to be conducted. The FWS concluded, after reviewing data submitted by the DOE, that the chemicals proposed to be released would have no adverse effect on the Desert Tortoise or its habitat. These test programs are now rescheduled for the 1990 test season.

1990 TEST SEASON

ANSUL CORPORATION VAPOR SUPPRESSION MITIGATION TESTS

This is the first of the rescheduled test programs and it has now been scheduled for the period from March 28, 1990 through April 21, 1990. Ansul Corporation has developed non-aqueous vapor suppressants for controlling releases of vapors from toxic and hazardous materials which in themselves are also clean-up agents. Ansul believes the advantage of these materials is their ability to efficiently suppress vapors and facilitate clean-up, but have not been able to verify these claims, hence their planned larger scale field studies at the LGFSTF.

The objective of these tests is to measure the degree of vapor mitigation and clean-up of the accidental spills of various hazardous and toxic materials which can be obtained by the application of Ansul proprietary spill control agents. This information will be useful to the manufacturers and users of these chemicals and to those who are called upon to respond to accidental spills in the transportation of these materials in inter- and intrastate commerce.

The Department is not privileged to the total cost of each test program; however, the estimated user-fee incremental costs DOE will require for the conduct of this test program is $250,000.

As no tests have been conducted in FY 1990 as yet, there are no results or conclusions available. However, activities fundamental to any tests conducted at the LGFSTF will include generation of technical data. DOE requires each sponsor to provide a Final Test Report which sets out the facts relating to the test or test series within one year of completion of the tests. The Department does not independently release to the public data generated during a test program without the approval of the test sponsor in advance to their analysis, release, or publication of the results and/or conclusions in appropriate technical journals. Therefore, in this series of tests, or any other tests which are wholly funded by the test sponsor, the Department does not analyze the data but obtains the results from the test sponsor after their analysis.

SILICONE HEALTH COUNCIL SILANE CHEMICALS VAPOR SUPPRESSION STUDY

This second test program, which was postponed during FY 1989, is now scheduled during the period from May 1, 1990 through May 27, 1990. It is sponsored by the Silicone Health Council (SHC) which represents six manufactures, users, and transporters of silane chemicals (DeGussa Corporation, Union Carbide, General Electric, Cabot Corporation and Petrarch Systems Silanes). The Ansul Corporation, 3M Corporation, MSA Research Corporation, and Chubb National Foam, Incorporated are participating in the tests by supplying various hazmat foams for the test series.

The silane chemicals are used as intermediates in the manufacture of a wide variety of commercial products including, but not limited to, high purity silicone for electronic devices, polishes, lubricants, fabric softeners, and fillers. Because of the health and safety concerns to the public and to the workers, certain members of the SHC recognizing these concerns have formed a consortium arrangement with the SHC to examine certain mitigating schemes in actual field studies to address these concerns. These tests are designed to determine if large fires of members of the silane family of chemicals can be extinguished using various hazmat foams. Another objective is to assess the ability of hazmat foams to mitigate vapors from spills of various members of the silane chemical family.

The Department has entered into a collaborative research and development initiative with SHC and the Environmental Protection Agency (EPA) to collect additional downwind gas dispersion and concentration data not originally proposed in the SHC Test Plan. DOE's contribution to the effort is $60,000 for test set-up, data collection and reduction. EPA's contribution is $94,500 for the test fluid and its cost of transportation to the site. SHC's contribution is $40,000 for specific instrumentation, data analysis and preparation of the report.

The estimated user-fee cost to SHC for this test program is $250,000 including the collaborative R&D initiative.

INTEGRITY OF TOTALLY ENCAPSULATED CHEMICAL PROTECTIVE SUITING MATERIALS TESTS

This third test program, tentatively rescheduled for the 1990 test season during late-May early-June 1990 is designed to determine the efficacy of totally chemical protective suiting materials in worse case exposures to toxic and/or hazardous chemicals.

As more knowledge as to the effects of hazardous and toxic materials on worker health and safety advances, the need to provide workers with totally encapsulated chemical protective (TECP) suits to allow them to carry out their jobs is common. Such jobs as hazardous material response, toxic waste dump clean-up, and chemical manufacture and use require totally complete encapsulation of the worker routinely and/or during accident situations. With this increased need and use of complete encapsulation in the workplace, a high degree of safety is now required in the material used in these suits.

The objective of these tests is to measure the level of protection commercially available totally encapsulated chemical protective (TECP) suits provide a wearer in very high concentrations of hazardous materials (chlorine and ammonia). TECP suits which are used by hazmat personnel in emergencies must have a high degree of protection as well as reliability.

This study is a collaborative research and development initiative among the Department, the Occupational Health and Safety Administration (OSHA), and the Department of Transportation. DOE's contribution to Phase II of this test program is $75,000 for site development, instrumentation and data collection network, and test conduct assistance. OSHA/DOT's contribution is $140,000 for Phase I, Laboratory Evaluation, and Phase II, Field Evaluation. Industry contribution, currently being solicited by the OSHA Test Director, (Hazards Control Department, Special Projects Group, Lawrence Livermore National Laboratory), is estimated at $30,000.

DOW CHEMICAL COMPANY CHLORINE VAPOR MITIGATION STUDY

There have been increasing safety and health concerns regarding the manufacture, transportation, and storage of chlorine gas. Such concern has prompted the State of California to propose regulations that would require zero emissions of chlorine from enclosed structures. This proposal has severe implications, especially in the municipal water districts who use huge quantities of this chemical in water treatment facilities. Dow Chemical Company has recognized the concern and the need to further their knowledge in mitigation techniques and strategies to remain competitive in the area. Dow, a supplier of chlorine used in the 1988 Chubb National Foam, Inc. studies, collected data during these tests which prompted them to conduct their own field studies at the LGFSTF.

The objective of these proposed tests is to determine the effectiveness of various water spray configurations to control and mitigate the effects of accidental releases of chlorine to the environment.

These tests have been tentatively scheduled for the June-July 1990 period.

DOE is currently working with the Dow Chemical Company to arrive at an estimate of the user-fee incremental costs Dow must provide DOE for the conduct of the tests.

CENTER FOR CHEMICAL PROCESS SAFETY (CCPS)/DOE AEROSOL FORMATION COLLABORATIVE TESTS

Materials that are stored above their atmospheric pressure boiling points (superheated liquids) form two-phase mixtures upon their sudden release to the atmosphere. A knowledge of the behavior of these materials from the time of release from containment until diluted below toxic or flammable limits is necessary if accurate risk determination of the extent of the potential hazard is to be estimated.

CCPS is a Directorate of the American Institute of Chemical Engineers and is privately funded by approximately 40 organizations representing manufacturers, users, and distributors of a wide range of chemicals and petroleum products. This is the third phase of a three phase CCPS project. The objective of these Phase III tests is to determine the near-field behavior and mechanism of aerosol formation of pressurized liquids (i.e., hydrogen fluoride) when they are released to the atmosphere in accident scenarios, and to verify the mathematical model developed in Phase I of this study to predict this behavior.

This test program is tentatively scheduled for four weeks around August 1990. Currently DOE is preparing an estimate of

the costs for this collaborative research and development initiative; however, DOE has committed up to $300,000 of FY 1989 collaborative research and development funds for the Phase III test design, test set-up, and data collection. The CCPS contribution is $200,000 for this Phase III effort. However, CCPS has provided $160,000 for development of the model in Phase I and $13,000 of an $180,000 effort in Phase II to determine the validity of the model. EPA provided the balance of $167,000 for the Phase II effort.

When the data is analyzed by CCPS, the report will be available to contributing agencies and the public through the National Technical Information Service.

1991 TEST SEASON

CONTINUOUS RELEASE DENSE GAS DISPERSION TESTS

Several test programs have been conducted at the LGFSTF through 1988. Three programs were conducted primarily to study atmospheric dispersion of denser-than-air clouds. Three other tests primarily addressed methods of reducing dense cloud hazard by various mitigation approaches. Data obtained from the dispersion tests has shown that mathematical models developed for dense gas dispersion provide predictions consistent with the test results. However, the data are not well suited for dense gas model evaluation because the tests involved phenomena which affects cloud density and, in turn, cloud dispersion.

The purpose of these tests is to provide data useful to the scientific community for generic testing and validation of dispersion models, specifically the personal computer version of the DEGADIS (Dense Gas Dispersion) model and to provide baseline data for the LGFSTF for subsequent use in evaluating dense gas releases and dense gas cloud hazard mitigation methods. These tests will demonstrate the utility of the LGFSTF and the technical capability of the DOE contractors, on- and off-site, who are involved in the DOE LGFSTF Program. These tests will be useful since there have been no tests at the LGFSTF which did not involve overriding uncertainties in data due to aerosol formation, chemical reaction, or other such complicating factors.

There has been no schedule developed for this test program as yet. The test plan is being developed by the Department. The EPA and the Department of Transportation have concurred in the usefulness of this project.

The DOE contribution is estimated at $150,000 for a test series of nine releases. Although EPA and DOT have concurred as to the usefulness of this test program, neither agency have available funds to co-fund

U.S. AIR FORCE

The Air Force has been concerned with worker health and safety as well as public health and safety should there be accidental releases of rocket propellants to the environment. The concern is not only with the toxic and hazardous vapors released, but also with the possibility of ignition and burn-off of the propellants.

The Air Force wishes to test the effectiveness of a new foam developed for suppressing the release of vapors from an accidental release of rocket propellants to the environment. Another objective of the proposed tests is to determine the effectiveness of this foam in controlling fires of rocket propellants mixed with diesel fuel to simulate a transportation accident where the propellants are mixed with fuel spilled from the carrier.

The Air Force has indicated that the LGFSTF is suitable for their test program and will be officially requesting DOE's approval to use the LGFSTF and to be queued for testing in Spring of 1991.

Mr. Bevill: Please provide an analysis of spending by object class for FY 1989, FY 1990 and FY 1991.

Mr. Gentile: The following is our analysis of spending by object class for FY 1989, FY 1990 and FY 1991.

FY 1989

OBJECT CLASS 11

Personnel compensation in the amount of $111,000 was for two full time permanent equivalents, one for the Program Manager at Headquarters and one in the field at the Nevada Operations Office.

OBJECT CLASS 12

$11,000 was allocated for personnel benefits associated with the Program Manager at Headquarters.

OBJECT CLASS 21

$22,000 was expended for Headquarters travel for marketing and technology transfer. This included meeting with potential

test sponsors at the LGFSTF, providing briefings at the LGFSTF for national and international industrial representatives interested in the Program and attending conferences, meetings and symposia, both national and international, as part of an outreach effort.

OBJECT CLASS 25

The $322,000 expended provided prospective users with assistance in the areas of; development of cost estimates, analysis of environmental and safety issues, environmental approvals, pre-test documentation, and scientific support. This amount is divided among four contracts, $139,000 to Joint Venture 1, $92,000 to Western Research Institute, $88,000 to Opus Corporation and $3,000 fee for membership on the International Vapor Cloud Research Committee.

$100,000 was provided the Lawrence Livermore National Laboratory to provide the Nevada Operations Office (NV) for scientific advisory support as required for sponsored test programs at the LGFSTF. The balance totaling $665,000 was transferred to NV to continue; maintenance of the LGFSTF, facility baseline operations support, and technical assistance to test sponsors. Included in this amount are monies available to support the DOE/EPA/DOT collaborative research and development program.

FISCAL YEAR 1990 and FISCAL YEAR 1991

OBJECT CLASS 11

Personnel compensation increased $4,000 from FY 1989 to FY 1990 and $2,000 from FY 1990 to FY 1991.

OBJECT CLASS 12

The increase in personnel benefits from $11,000 to $12,000 from FY 1989 to FY 1990 attributed to cost-of-living. There is no adjustment for cost-of-living in this object class in FY 1991.

OBJECT CLASS 21

The increase for travel expenses of $1,000 each in FY 1990 and FY 1991 over the FY 1989 level will provide for a modest increase in the outreach marketing and technology transfer initiative while providing for the continued travel to participate in program and project review meetings at the LGFSTF, attend pertinent national and international meetings, conference and symposia.

OBJECT CLASS 25

The funds allotted for FY 1990 contractual services were reduced by $50,000 by Gramm-Rudman-Hollings sequester adjustments and Public Law 101-164 reductions to fund anti-drug activities. Overall reductions were applied to this object class. FY 1990 funding will still continue to provide for the activities previously described for FY 1989 for this class, albeit at a lower level. $515,000 will provide for the management and operation of the facility in support of potential users and to continue facility baseline operations support and technical assistance with test sponsors. The remaining $360,000 will support the collaborative DOE/EPA/DOT research and development program.

In FY 1991, the budget request of $1,085,000 is at the same level requested for FY 1990 without the adjustments mentioned above. The increase of $57,000 will allow for a modest increase in the collaborative research and development program.

Mr. Bevill: Please describe the status of the collaborative DOE/EPA/DOT long-range R&D program. What activities are planned in FY 1990 and FY 1991?

Mr. Gentile: The current status and the activities planned in FY 1990 and FY 1991 under the DOE/EPA/DOE long-range R&D program follow.

The Memorandum of Understanding which the Department entered into with the Environmental Protection Agency (EPA) and the Department of Transportation (DOT) is active. As directed by Congress, the Department has contracted with the Western Research Institute in Laramie, Wyoming to provide technical and analytical support to the collaborative effort. The following are the activities planned thus far for the collaborative research and development program:

Part of the collaborative outreach efforts in FY 1990 is the continuation of a Department FY 1989 initiative to enter into a research and development effort with the Center for Chemical Process Safety (CCPS), a Directorate of the American Institute of Chemical Engineers. This initiative involved the utilization of the Liquefied Gaseous Fuels Spill Test Facility (LGFSTF) in the third phase of a three phase study to study the formation of aerosols generated during the accidental releases of toxic or hazardous liquids and to verify a model developed in the earlier phases of the project using EPA and CCPS funds. The field series of tests

will be conducted at the LGFSTF during the 1990 test season. The Department has agreed to use LGFSTF funds appropriated in FY 1989 to participate in the collaborative effort. The CCPS is currently developing the specific test plan while adhering to the Department's safety and environmental guidelines.

In addition, in FY 1989 the Department agreed with the American Petroleum Institute (API) on the need for a user friendly version of the Dense Gas Dispersion (DEGADIS) model for use on a personal computer (PC). The PC version of the model will make it user-friendly and be able to be used more easily in field situations. The API has agreed to make the model and appropriate documentation available through the National Technical Information Service after verification that it performs in the identical manner as the larger computer version. The API has funded the translation of the model which will be completed in FY 1990. The Department's collaborative effort will be to ensure that the resulting model is consistent with the existing DEGADIS model developed and refined by the EPA and the Coast Guard in prior years. DOE will also fund the installation and verification of the PC version at the LGFSTF through a series of releases of a benign gas during FY 1991. The EPA and DOT have concurred in the merit of this effort.

The Department, along with the EPA and The Department of Defense (DOD), entered into an Interagency Agreement to translate the Heavy Gas Database formally maintained by Lawrence Livermore National Laboratory (LLNL). LLNL was in the process of upgrading their computer system to a system that was not available to a large population. Therefore, it was in the best interest of the scientific community to translate this data to a more readily available system. The Heavy Gas Database contains results of heavier-than-air gas research, some of which was generated at the LGFSTF. This data base translation project was cost-shared among DOE, EPA, and the DOD. The translated data was transferred to and now managed by the Western Research Institute where it is readily available to the public to use, for example, to formulate their own test plans. This effort will continue into FY 1991.

In FY 1990, DOE is also providing collaborative research funds under an Interagency Agreement with OSHA and DOT to support, in part, testing of totally encapsulated chemical protective (TECP) suits in worst case chemical exposures at the newly added capability, a small scale spill facility. Initial planning calls for exposure of TECP suits to extended high concentration streams of chlorine and ammonia using both static and articulated mannequins.

Another collaborative outreach effort in FY 1990 is underway with the EPA and the Silicone Health Council (SHC). This

test program is designed to determine downwind concentrations of hydrogen chloride (HCl) vapor released after water spray mitigation of the silane test fluid. The HCl vapor is a reactant product of water and the test fluid. DOT has concurred in this initiative.

APPROPRIATIONS STRUCTURE AND REPROGRAMMING GUIDELINES

Mr. Bevill. The Committee is pleased to see the Administration provide support and initiatives for the environmental restoration program.

I am concerned, however, that these initiatives are proposed to begin in FY 1990 and the Department has not sought the approval of Congress to change from the way the funds were appropriated.

The Committee has worked well with the Department in the past, but I want to make it very clear that the funds are to be used for the purposes appropriated unless a reprogramming has been proposed and accepted.

I would like your assurances that you will not divert the funds appropriated without an approved reprogramming.

Mr. Duffy. The Department understands the Committee's direction that funds are to be used for the purposes appropriated unless reprogramming has been proposed and accepted. The Department has submitted a reprogramming and will not utilize funds in a manner not provided for in the appropriation.

Mr. Bevill. In the report accompanying the Department's FY 1984 appropriation, the Committee expressed strong concern over the Department's repeated changes in program and appropriation structure. The report states that "In the future, all structure changes shall be approved by the Committee prior to the submission of the annual budget." The Department has now proposed a new appropriation. Please advise why the Department considered it inappropriate to comply with the Committee with regard to this issue.

Mr. Duffy. The Department recognizes the Committee's desire that proposed restructuring be agreed to by the Committee before the budget is submitted. We try to comply with this direction as best we can. Unfortunately the timing for this structure change did not permit us to fully comply.

The Environmental Restoration and Waste Management Five-Year Plan published in August, 1989 recommended that all environmental activities covered in the Five-Year Plan be combined in as single appropriation to give this important work the visibility and flexibility necessary. The Department worked with OMB thru the Fall to get agreement on this new account and it was not finally agreed to until December 1989. Given this timing we simply did not have time to obtain Congressional approval prior to submitting the FY 1991 budget to Congress. Our only other alternative would have been to delay the structure change until FY 1992. However, because of the importance of moving out quickly to give this program focus it could not be delayed for a year without substantial impact. Given this dilemma we briefed the Committee staff on our restructuring plans as soon as it was finalized. We realize that this does not constitute obtaining approval but given the timing was the best we could do.

Please be assured that the Department is aware of your desire to approve in advance structuring changes and will make every attempt to comply in the future. However, we hope you understand the extenuating circumstances in this particular situation and will approve the structure as submitted.

Mr. Bevill. Your budget has taken a number of activities included in the FY 1990 appropriation and combined them to form new activities. Your FY 1990 program description assumes these reprogrammings have been approved. When can the Committee expect to see a proposed reprogramming for these FY 1990 programs?

Mr. Duffy. The Department submitted a proposed reprogramming to the Committee on March 1, 1990.

REFORMULATION OF BUDGET INTO FY 1990 STRUCTURE

Mr. Bevill. Please provide the Committee with a detailed crosswalk that shows the FY 1990 program as appropriated; the segregation of these programs into the proposed FY 1990 structure, the FY 1991 budget in the FY 1990 appropriation structure, and the segregation of these programs into the proposed FY 1991 structure.

Mr. Duffy. We are in the process of developing the detailed information for the Committee. The FY 1991 budget for Environmental Restoration and Waste Management was formulated on the basis of a unified, single appropriations account. Recasting the budget back into the FY 1990 structure will be completed by March 30, 1990.

Mr. Bevill. Your budget describes a program equaling $2,933.4 million and then shows an unspecified reduction of $142.00 million. No other portion of the Department's budget is presented in this manner. Please describe why your budget does not show how much funds are requested for each activity.

Mr. Duffy. The program of work described in the FY 1991 budget would require $2.933 billion. However, the Departmental recognizes project slippages estimated at $142 million are likely, thereby reducing the request to $2.791 billion. This program is comprised of a large number of projects (over 1500) and we expect delays in attracting and acquiring the required technical and administrative staff at DOE and in the States to administer this large, complex program. As examples, we are experiencing delays in gaining needed regulatory approvals such as community relations plans, remedial investigation work plans, facility investigation work plans and RCRA closure plans.

We cannot, at this time, identify the specific projects subject to the slippages. In our internal planning for execution of the FY 1991 budget we have assigned a percentage target which will be adjusted by actual operating experience. We will keep the Committee informed throughout the course of the upcoming fiscal year.

GENERAL REDUCTION FOR ENVIRONMENTAL CLEANUP ACCOUNT

Mr. Bevill. Please provide a complete breakdown of your budget summary showing how you would anticipate applying your proposed $142.0 million general reduction?

Mr. Duffy. As indicated in response to an earlier question, we cannot identify the specific projects subject to the slippages. In our internal planning for execution of the FY 1991 budget we have assigned a percentage target reduction which will be adjusted by actual operating experience. We will keep the Committee informed on this matter throughout the course of the upcoming fiscal year.

BUDGET STRUCTURES

Mr. Bevill. Please provide a complete breakdown of your budget showing FY 1990 as appropriated and FY 1991 in the FY 1990 appropriation structure as well as your proposed structure.

Mr. Duffy. The Environmental Restoration Program included in the FY 1991 budget submission is composed of activities formerly budgeted in the Office of Energy Research; the Office of Nuclear Energy; and the Office of Defense Programs (DP). The first two Offices' activities were budgeted under the Energy Supply Research and Development appropriation and the DP activities were under the Atomic Energy Defense appropriation account. I would like to supply for the record, a summary level table which shows the FY 1990 and FY 1991 budget activities distributed in the FY 1991 structure broken by the FY 1990 office structure.

(The information follows.)

	FY 1990 Non-Defense ER	NE	Defense EM/DP	TOTAL FY 1990
FACILITIES AND SITES				
CERCLA	329	15181	62421	77931
RCRA	182	0	195422	195604
RCRA/CERCLA	6765	0	204807	211572
D&D	4094	15476	43890	63460
Subtotal	11370	30657	506540	548567
FUSRAP	0	14643	0	14643
UMTRAP & GROUNDWATER	0	93619	0	93619
Total Envir. Restoration	11370	138919	506540	656829

	FY 1991 Non-Defense ER	NE	Defense EM/DP	TOTAL FY 1991
FACILITIES AND SITES				
CERCLA	5664	38798	129523	173985
RCRA	65	0	164322	164387
RCRA/CERCLA	11050	0	252818	263868
D&D	5456	26472	86552	118480
Subtotal	22235	65270	633215	720720
FUSRAP	0	36200	0	36200
UMTRAP	0	125500	0	125500
Total Envir. Restoration	22235	226970	633215	882420

AUTHORIZATION JURISDICTION

Mr. Bevill. Your FY 1991 budget combines funds authorized by a number of House and Senate authorizing committees. You propose combining 050 Defense activities with activities authorized as civilian programs. What agreement has the Department sought and received from the applicable authorizing committees?

Mr. Duffy. The Department has had numerous meetings with the staffs and selected members of various authorizing committees concerning the formulation and content of the Five-Year Plan (Plan). We have fostered a free exchange of information with Congress and have attempted to be responsive to any inquiries on the Plan. We neither solicited or were provided guidance by the committees on the matter of jurisdiction.

Mr. Bevill. What authorizing committee does the Department propose to have jurisdiction over its new Environmental Restoration and Waste Management account?

Mr. Duffy. We consider it presumptuous of this Department to recommend authorization jurisdiction for the Environmental Restoration and Waste Management account. We assume the committee rules determine such matters. As indicated earlier, during the numerous committee staff briefings conducted by DOE on the Five-Year Plan, funding for which is now contained in the proposed Environmental Restoration and Waste Management account, we neither solicited or were given guidance by the committees on the matter of jurisdiction.

NEW RISK BASED PRIORITIZATION METHODOLOGY

Mr. Bevill. Please describe your proposed "New Risk Based Prioritization Methodology". Describe how this methodology is used in developing your budget.

Mr. Duffy. A new prioritization methodology is currently under development but was not used in developing the FY 1991 budget submission. A simple, four-tiered system in the Five-Year Plan was used to develop the FY 1991 budget. A new priority system may be used to develop the FY 1992 budget currently being formulated. A priority system is being designed with participation from a priority system External Review Group composed of States, and the Environmental Protection Agency.

This system is based on three well-recognized and accepted component techniques: risk assessment, multi-objective decision analysis, and formal budgeting theory. In operation, the system is envisioned to involve several steps which I would like to provide for the record.

(The information follows.)

PROPOSED PRIORITIZATION STEPS

Identification of budgetary decision units related to the existing program structure.

Development of alternative activity packages and associated budgetary levels for each unit.

Ranking of the alternatives taking into account both the extent to which they achieve identifiable program goals and their cost. Program goals have been carefully developed with full participation of affected parties and include health risk impact, environmental impact,

regulatory requirements, uncertainty resolution, cost impacts, and possibly others.

Consideration of the longer-term costs of activities that extend beyond the budget year in question.

Computation of overall budget levels and funding allocations that maximize benefits and sensitivity analyses.

A determination on the adoption of a new prioritization methodology for the Five-Year Plan will be made in the next 60-90 days.

Mr. Bevill. Your budget states that all priority 1, 2 or 3 activities are funded in compliance-related activities. How much of the $142.0 million reduction included in your budget will be applied to this activity and what effect will the reduction have on your ability to fund all priority 1, 2 and 3 activities?

Mr. Duffy. As indicated in response to a similar question, we cannot identify the specific projects subject to the slippages. The appropriation levels projected in the FY 1991 budget will permit the funding of all priority 1, 2 and most of 3 of the Five-Year Plan issued last August.

FY 1991 BUDGET REQUEST FOR TECHNOLOGY DEVELOPMENT

Mr. Bevill. Your budget for Technology Development in FY 1990 shows $183.5 million being available. Please show where these funds are derived using the FY 1991 appropriation structure.

Mr. Duffy. The fiscal year 1990 budget for Technology Development is $183.5 million. Using the FY 1990 appropriation structure, the breakdown of the manner in which this $183.5 million was derived is shown in a table which I would like to insert for the record. A reprogramming action was submitted by the Department dated March 1, 1990. (The information follows:)

FISCAL YEAR 1990 TECHNOLOGY DEVELOPMENT FUNDING
(IN MILLIONS OF DOLLARS)

Appropriation/Activity	FY 1990 Appropriation
Atomic Energy Defense Activities (Defense)	
Operating Expenses:	
Weapons Activities	
Production and Surveillance	$ 5.9
Materials Production	
Supporting Services	5.5
Defense Waste and Environmental Restoration	
Waste Operations and Projects	1.2
Waste Research and Development	43.4
Hazardous Waste Compliance Technology	39.6
Environmental Restoration	84.5
Subtotal, Operating Expenses	180.1
Capital Equipment:	
Weapons Activities	
Production and Surveillance	.9
Materials Production	.5
Defense Waste and Environmental Restoration	2.0
Subtotal, Capital Equipment	3.4
TOTAL, Atomic Energy Defense Activities	$183.5

ENVIRONMENTAL AND MOLECULAR SCIENCE LABORATORY

Mr. Bevill. Please describe the Environmental and Molecular Science Laboratory and indicate the possible uses of this facility.

Mr. Duffy. The Environmental and Molecular Science Laboratory will be a new facility with state-of-the-art laboratory facilities, scientific equipment and computer hardware to support a forefront interdisciplinary effort in environmental, physical, chemical, materials, biological and computer sciences. The purpose is to provide a molecular level understanding of phenomena important to development of more cost effective and efficient approaches to environmental restoration and waste management as well as energy supply and utilization. It will be a facility open to scientists and engineers from the academic community, industry and other government laboratories. In addition, it will house the Molecular Science Research Center and support the Environmental Science Research Center at Pacific Northwest Laboratory. These are basic research programs to underpin broader programs at Hanford, particularly those in environmental restoration and waste management.

Mr. Bevill. What predominant use of the Environmental and Molecular Science Laboratory require its funding in the Environmental Restoration and Waste Management budget?

Mr. Duffy. Basic research is necessary to development of new technological approaches to environmental restoration and waste management that are more effective and less costly. A basic/applied research working group has been established to coordinate between basic research programs under the Office of Energy Research and applied research, development and

demonstration under the Office of Environmental Restoration and Waste Management. This coordination can be facilitated by location of a basic research facility at a site where major environmental restoration and waste management activity is being carried out. Support for the initial planning and design effort for EMSL by Environmental Restoration and Waste Management, pending a decision on proceeding with construction and on a program sponsor, is consistent with the objective of close coordination and mutual support between these programs.

Mr. Bevill. Is the construction of this facility included in the five-year budget projections for the Environmental Restoration and Waste Management budget?

Mr. Duffy. Construction of the Environmental and Molecular Science Laboratory is not included in the budget planning of the Environmental Restoration and Waste Management Program. A decision on whether to proceed with construction and the programmatic sponsor will be made at the conclusion of the planning and design work to be done in FY 1991.

USING ACTINIDE BURNERS FOR WASTE MANAGEMENT

Mr. Bevill. To what extent is research on the use of an actinide burner as a solution to the waste management program funded in your technology development budget?

Mr. Duffy. Actinide burn-up is not directly funded in the Fiscal Year 1990 Office of Technology Development budget. A workshop on actinide separation technologies necessary to support actinide burn-up will be held on March 15-16, 1990. The workshop will produce a method to be used in comparing the merits of existing and developing waste separation technologies. Research proposals on actinide separation were received from several DOE field offices and laboratories. These will be technically reviewed during the workshop.

DETAILED BREAKDOWN FY 1991 BUDGET FOR TECHNOLOGY DEVELOPMENT

Mr. Bevill. Please provide a list and description of all projects anticipated in the FY 1991 Technology Development budget. Also, include the FY 1990 and FY 1991 funding for each project.

Mr. Duffy. At the present time, a distribution by project of the FY 1991 Technology Development Program budget has not been determined. Funding distributions will be known only after candidate technologies are competed and the selection process completed.

The principle objective of the Technology Development Program is to resolve major technical issues and rapidly advance beyond current technologies for environmental restoration and waste management operations. At the heart of this objective is a time-phased, needs driven, selection of cleanup technologies. Because of pressures of time and cost, we will not pursue all alternatives for cleanup. Rather, DOE needs that are ubiquitous such as groundwater remediation, solvent extraction from soils, waste minimization, and in-situ waste stabilization will drive the selection of technologies that have wide application. Emphasis will be placed in the near-term on improved or new technology for (1) characterization of sites to determine the magnitude and extent of contamination and its physical and chemical nature, and (2) barriers to prevent or control the spread of contamination. Industrial, university, and DOE laboratory methods are being studied for the most capable and effective restoration and treatment techniques which can be applied to a broad range of DOE site problems. Promising new initiatives will replace efforts that have less potential for impacting key environmental restoration and waste management problems.

COORDINATION WITH OTHER R&D

Mr. Bevill. Please indicate how the Department coordinates those activities funded in your Technology Development budget with other research with potential waste applications.

Mr. Duffy. We are leveraging the use of our technology funds by three principal means. First, we are applying the results of other DOE research and technology programs, such as the subsurface science programs of DOE's Office of Health and Environmental Research. Second, we are negotiating interagency agreements that take advantage of similar environmental research and development initiatives; we have already negotiated such agreements with the Environmental Protection Agency and National Institute of Standards and Technology, and we are in the final stages of concluding several agreements with the Department of Defense. Finally, we are supporting innovative research and development and technology development through the support of university consortia in New Mexico and South Carolina. Scientists in these programs are collaborating with their peers in DOE's national laboratories to ensure application of their results of DOE's environmental problems.

USING SOLAR THERMAL RESEARCH FOR HAZARDOUS WASTE

Mr. Bevill. Have you considered the solar thermal research on the use of intense solar energy to detoxify hazardous waste as a candidate for your budget?

Mr. Duffy. Solar energy research in this field is being supported by the Office of the Assistant Secretary for Conservation and Renewable Energy. Coordination with this office is maintained by the Environmental Restoration and Waste Management Program to evaluate applicability of solar energy research to waste and environmental cleanup problems.

IN-SITU VITRIFICATION

Mr. Bevill. Please describe the possible application of in-situ vitrification. Describe the past and anticipated future development of this activity.

Mr. Duffy. There have been ongoing laboratory and preliminary field investigations of in-situ vitrification for approximately 8 years. In the future, we anticipate conducting full-scale field tests of the applicability of the technique to formerly used DOE waste sites. Possible applications include the stabilization of waste sites containing hazardous waste and low-level radioactive waste.

CAPITAL EQUIPMENT FOR TECHNOLOGY DEVELOPMENT

Mr. Bevill. Please justify the increase in capital equipment funding in Technology Development in FY 1991.

Mr. Duffy. The FY 1991 capital equipment request for the Technology Development Program is $16.8 million, a $13.5 million increase over FY 1990. The growth from FY 1990 to FY 1991 is due primarily to the fact that the Technology Development Program was newly established in FY 1990 with a budget that was essentially all operating dollars. The FY 1991 request establishes a Technology Development Program equipment budget.

The FY 1991 capital request provides critical base research, development, demonstration, testing, and education equipment for all Technology Development Program activities. These equipment needs consist mainly of items specially adapted to Technology Development projects with a lifespan of several years that are either unavailable through rental or lease or for which rental or lease costs significantly exceed the package price. Examples of requirements include pilot-scale robotic waste handling equipment, remote exhumation equipment for buried mixed waste retrieval demonstration, in-situ vitrification equipment, cryogenic containment equipment, and equipment to conduct analysis and monitoring.

FUNDING FOR COMPLIANCE ACTIVITIES

Mr. Bevill. Describe the funding for compliance activities in FY 1990 and FY 1991.

Mr. Duffy. Compliance activities under the Environmental Restoration program are those activities that include assessment and cleanup of surplus facilities and inactive sites. The Facilities and Sites portion of the Environmental Restoration budget consists of activities required to meet compliance. The FY 1990 as appropriated and FY 1991 as requested, funding distributions ensure that all compliance related activities are funded. Compliance activities for assessment and cleanup are governed by Interagency Agreements; Federal Facility Agreements; State Agreements; DOE Orders; State and Federal Laws; and other Regulations.

Mr. Bevill. Describe the importance of maintaining a funding allowance for compliance and indicate why this category of funding has not been proposed as a separate budget element.

Mr. Duffy. This is a major problem which must be resolved with this Committee's support and guidance. We must have a mechanism that ensures adequate funding so that facilities operating under compliance agreements doe not fall out of compliance due to funding shortfalls. We are exploring options. For example, the budget could include a contingency fund to be used only for required additional payments to meet compliance agreements--with appropriate notification to the Committees as required. Reprogramming guidelines could be amended to permit mandatory payments such as the use of any unobligated balances with subsequent Committee notification and submission of the required formal reprogramming.

We will consult with the Committee staff when we are satisfied that we have explored the appropriate alternatives and seek your approval to implement a more workable funding mechanism to resolve this problem area.

As to proposing compliance activities as a separate budget activity, many of the elements of this program are to meet "compliance activities". This term is used to define a broad spectrum of activities, for example:

- Federal Facilities Corrective Actions
- Compliance Order Action
- Consent Decree Actions
- Requirements of Bi and Tri-Party Agreement
- Compliance with existing regulations, DOE Orders

Identification of all of these Compliance Activities in one place in the budget structure would not, in our view, provide the programs detail needed to examine, administer and control this large complex program.

FACILITIES AND SITES

Mr. Bevill. Describe the FY 1989, FY 1990, and FY 1991 Environmental Restoration Program for "Facilities and Sites".

Mr. Duffy. The Facilities and Sites activity was first established in the current FY 1991 budget submittal to Congress. This program activity consists of remedial actions and decontamination and decommissioning (D&D) efforts to reduce and/or remove the potential risks to the environment and to human health and safety resulting from past Departmental activities. In this new activity, all remedial actions and D&D activities previously budgeted under the Office of Defense Programs; Nuclear Energy, Energy Supply Research and Development appropriation activities; and the Office of Energy Research have been consolidated to better address these cleanup efforts and achieve a more cost effective and efficient reporting on Departmental compliance activities. The consolidation of these efforts will enhance the implementation of the Five-Year Plan.

Specific activities under Facilities and Sites deal with all aspects of assessment and cleanup of inactive potential release sites. The overall assessment and cleanup process contains six phases; preliminary assessment, inspections, characterization, evaluation of cleanup alternatives, cleanup action, and compliance.

FORMERLY UTILIZED SITES REMEDIAL ACTION PROJECT

Mr. Bevill. Describe your FY 1989, FY 1990 and FY 1991 program for the Formerly Utilized Sites Remedial Action project.

Mr. Duffy. During FY 1989, efforts continued at numerous sites under the Formerly Utilized Sites Remedial Action Project (FUSRAP). Significant progress was made on the assessment phase for a number of the sites. Interim remedial action and disposal of waste materials from the Aliquippa Forge, Pennsylvania site was completed. Site characterization and decontamination of the concrete pads at the Elza Gate, Tennessee site were completed. Remedial action on vicinity properties located near the St. Louis Airport Site in Missouri was initiated.

During FY 1990, field investigations of residential properties at the Maywood, New Jersey site are continuing. Activities were initiated to prepare the Remedial Investigation/Feasibility Study - Environmental Impact Statement (RI/FS-EIS) for the Maywood site and these efforts will continue during FY 1991. Negotiations with the Environmental Protection Agency (EPA) on a Federal Facility Agreement (FFA) are continuing and the FFA is expected to be signed during FY 1990. Remedial Investigations of the Stepan property will be performed in FY 1991 and characterization of Lodi vicinity properties will be completed. Ongoing negotiations with the EPA will result in a signed FFA in FY 1990 for the Wayne, New Jersey site. Efforts have been initiated on preparation of the necessary RI/FS-EIS documents and these activities will continue in FY 1991.

At the Colonie, New York site, efforts are continuing on preparation of the RI/FS-Environmental Assessment (EA) during FY 1990 and will be finalized in FY 1991. The Record of Decision will then be issued to determine the disposition of wastes at this site. Removal of asbestos and equipment from the Colonie, New York site building will be initiated in FY 1991 and building demolition will commence. Planning documents and characterization reports for the Ashland #1, Ashland #2,

and Linde, New York sites will be issued in FY 1990. The preparation of RI/FS-EIS documents will be initiated for the New York Disposal Site. Remedial investigations of vicinity properties in Linde, New York will be initiated in FY 1991.

Cleanup of vicinity properties around the St. Louis Airport Site (SLAPS) in Missouri will continue in FY 1990 and FY 1991. Negotiations are continuing to reach an agreement with the EPA and the State of Missouri on SLAPS and on the nearby Hazelwood, Missouri site. Preparation of the RI/FS-EIS documents for both sites were initiated in FY 1990 and will continue in FY 1991.

URANIUM MILL TAILINGS REMEDIAL ACTION PROJECT

Mr. Bevill. Describe your FY 1989, FY 1990, and FY 1991 program for Uranium Mill Tailings Remedial Action.

Mr. Duffy. During FY 1989, work was underway at 13 of the 24 processing sites. Remedial action continued at Ambrosia Lake, New Mexico; Durango, Colorado; Lakeview, Oregon; Mexican Hat, Utah; the two sites at Rifle, Colorado; Riverton, Wyoming; and Tuba City, Arizona. Processing site remedial action was initiated at Green River, Utah; Grand Junction, Colorado; Monument Valley, Arizona; and Spook, Wyoming. The work at Salt Lake City, Utah and Spook, Wyoming was completed, as well as cleanup of vicinity properties at Edgemont, South Dakota. Remedial action at approximately 740 other vicinity properties was either completed or initiated. Site acquisition efforts were initiated for the Falls City, Texas, and Gunnison, Colorado sites. During FY 1990, remedial action will be underway at nine processing sites, and an estimated 700 vicinity properties will be completed or initiated. During the first quarter of FY 1990, remedial actions were completed at Green River, Utah; Riverton, Wyoming; and Lakeview, Oregon, bringing the total of completed sites to seven. Remedial actions at Tuba City, Arizona are scheduled to be completed during FY 1990. Remedial actions at Falls City, Texas, are scheduled to begin late in FY 1990. Site remedial action will continue at Grand Junction and Durango, Colorado. During FY 1991, remedial action will be underway at nine processing sites and an estimated 490 vicinity properties will be completed or initiated. Remedial actions will be resumed at the two Rifle, Colorado sites; at Mexican Hat, Utah; Monument Valley, Arizona; and Ambrosia Lake, New Mexico. Remedial actions will be completed at Durango, Colorado. Remedial actions will continue at Falls City, Texas and Grand Junction, Colorado and will be initiated at Gunnison, Colorado. Additional details on plans for the various sites are shown on the Key Activity Summary for the Uranium Mill Tailings Remedial Action Project included with the budget submission.

WEST VALLEY CLEANUP PROJECT

Mr. Bevill. Describe the status and schedule of the West Valley cleanup project.

Mr. Duffy. Approximately 70 percent of the area of the former spent nuclear fuel reprocessing plant building at West Valley has been cleaned out for reuse by the project. Four systems to process the liquid high-level radioactive waste stored at the West Valley site have been developed and in operation since May 1988. This initial processing step will effect a 90 percent reduction in the volume of high-level waste that needs to be solidified. As of the end of February 1990, over 50 percent of the liquid high-level waste has been pretreated and the residual waste stream has resulted in 7,000 containers of cemented low-level waste. The glass melter system that will be used to solidify the high-level waste has been undergoing testing with nonradioactive feed chemicals for the past 5 years. This testing is now complete, and the melter will be disassembled and its condition assessed. The conversion of the nonradioactive melter system to a system capable of solidifying radioactive high-level waste will take place over the next few years. In cooperation with the State of New York, work has begun on the preparation of the Environmental Impact Statement for completion of the project (by the Department, in cooperation with the State of New York) and for closing the site by the State of New York.

The schedule for beginning the radioactive high-level waste solidification is being reviewed to assess the impact of current and projected environmental and safety regulations, the impact of a Federal Facility Compliance Agreement that will be negotiated with the Environmental Protection Agency for managing radioactive mixed waste, and compliance actions identified

by the July 1989 Tiger Team Assessment of the project. An associated revised total project cost estimate for the waste solidification phase of the project is also being developed. We expect to have these revised schedule and cost estimates by June 1990.

DEFENSE RELATED FUNDING FOR ENVIRONMENTAL CLEANUP

Mr. Bevill. Please identify at the budget level of detail the defense and non-defense portions of the FY 1990 and the FY 1991 funding request?

Mr. Duffy. The following table summarizes funding, segmented to depict defense related efforts, for the five major activities which comprise the proposed Environmental Restoration and Waste Management account.

ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT

FUNDING SUMMARY

(dollars in millions)

	FY 1990 APPROPRIATIONS		FY 1991 REQUEST	
	Total	Defense Related	Total	Defense Related
Waste Management	$1,247.7	$1,125.6	$1,652.3	$1,516.7
Corrective Activities	124.7	107.7	168.6	141.5
Environmental Restoration	656.8	506.6	882.4	633.2
Technology Development	183.5	183.3	206.0	200.3
Program Direction	5.6	2.0	24.1	-
TOTALS	$2,218.3	$1,925.2	$2,933.4	$2,491.7
Less Adjustment for Slippages			-142.0	
ADJUSTED TOTAL			$2,791.4	

SAVANNAH RIVER GROUNDWATER REPORT

Mr. Bevill. The Committee requested from the Department by December 15, 1989, a plan, including a schedule, for the permanent isolation and containment or removal of the Containments of the seepage basins at the Savannah River site. The Committee has yet to receive a response. What is the status of this plan and when will it be submitted to the Committee?

Mr. Duffy. A draft of the Savannah River groundwater report was submitted to Headquarters in mid-December 1989 for review. Comments on this draft were provided to Savannah River in January 1990. A revised version of the report is due back into Headquarters by late March 1990. After clearance by other DOE Headquarters organizations, the report will be forwarded to the Committee.

WASTE ISOLATION PILOT PLANT

Mr. Bevill. Describe the R&D program planned and underway for WIPP. What issues is this R&D trying to resolve?

Mr. Duffy. Currently WIPP has several R&D activities ongoing and planned to address long-term performance of the repository.

These experiments address:

- quantity and rate of brine inflow
- seal system for boreholes, waste panels and shafts
- salt creep closure in disposal rooms
- disturbed rock zone permeability
- gas permeability of the repository rock salt

In addition to the testing at the WIPP facility, there are also several laboratory experiments and modelling efforts to help address the above issues.

Mr. Bevill. How many oversight/audit groups are currently reviewing some aspect of the Waste Isolation Pilot Plant? What is the status of these reviews?

Mr. Duffy. WIPP has been and continues to be reviewed extensively both internally and externally. In total there are nine oversight groups that are external to the WIPP Project. These include the National Academy of Sciences, the New Mexico Environmental Evaluation Group, the New Mexico State Environmental Improvement Division, the Environmental Protection Agency, the Advisory Committee on Nuclear Facility Safety, the Defense Nuclear Facility Safety Board, the Blue Ribbon Panel, the DOE Office of Environment, Safety and Health, and the Albuquerque Operations Office. The review scope of these groups include operational and long-term safety, test planning, waste characterization, retrieval planning, engineering alternatives, and mixed waste regulatory compliance.

We are in the process of responding to the comments of these groups, and the process and schedule for this are described in Revision 2 of the WIPP Decision Plan.

FUNDING SUMMARY FOR WIPP

Mr. Bevill. The budget request for WIPP operating expenses increases from $79 million in FY 1990 to $112.2 million in FY 1991. Please provide a breakout of funding by activity for both fiscal years.

WIPP FUNDING
(Dollars in Millions)

	FY 1990	FY 1991
Research and Development	$ 36.6	$ 56.6
Engineering	4.5	9.1
Operations	23.3	32.0
Environmental Compliance	1.9	2.3
Project Management	10.5	11.6
State of New Mexico Support	2.2	.6
TOTAL	$ 79.0	$112.2

STATUS OF WIPP

Mr. Bevill. What is the status of the land withdrawal legislation?

Mr. Duffy. Last month a draft bill was circulated for review within the Administration. Comments have been incorporated and revised language was resubmitted to the Office of Management and Budget last week. We expect the proposed legislation to be submitted to Congress shortly.

Mr. Bevill. When is WIPP scheduled to open and receive its first shipment of waste?

Mr. Duffy. I appreciate the significant interest in when we will actually be ready to ship waste to WIPP. The Secretary has stated that he will not be driven by schedules and that he will begin the test phase at WIPP only when he is fully satisfied that it can be conducted safely.

Although the preferred alternative is to begin a Test Phase at WIPP with only a limited amount of waste, this is still a first-of-a-kind facility. Many requirements must be met and many are not under DOE control. For example, recently we were advised by the EPA that they would not have their review of the No-Migration Variance Petition completed until April and that the public comment would not be completed until June. We expect that by June we will have sufficient information to identify a date for receipt of waste at WIPP for the Test Phase.

Mr. Bevill. How much waste will WIPP receive in its first year of operation?

Mr. Duffy. Our current plan is to initially receive approximately 0.5% of the WIPP design capacity for the bin and alcove tests over a one-to-two year period. Approximately 70 shipments of TRU waste (each containing the

equivalent of 42x55-gallon drums) are anticipated during the first year of the Test Phase. Implementation of the two-room performance monitoring test recommended by EPA would utilize another 1.5% of waste at WIPP during the Test Phase.

Mr. Bevill. Please identify and briefly describe the status of the outstanding issues which must be resolved before WIPP can be opened.

Mr. Duffy. The prerequisites to the initiation of the Test Phase with waste at WIPP are identified on the Secretary's Decision Plan. The latest update of the Decision Plan, Revision 2 (February 22, 1990), has been provided to key members of Congress. Congressional staff were briefed by DOE on the status of all the prerequisites on Revision 2 on February 22, 1990. The key prerequisites include land withdrawal; No-Migration Variance petition; Final Safety Analysis Report; and, Record of Decision for the Final Supplement to the Environmental Impact Statement.

Mr. Bevill. What is the status of payment of funds for roads to the State of New Mexico?

Mr. Duffy. DOE has made and continues to make a good faith effort to work with the State of New Mexico concerning highway improvements.

The State of New Mexico received approximately $54.4 million for highway improvement construction between fiscal years 1983 and 1987 in funds appropriated to the Department of Transportation. In order to complete the road improvements identified by New Mexico, DOE reprogrammed $43 million in 1989. However, DOE received Congressional direction that the funds could not be expended until land is withdrawn.

Mr. Bevill. Will the TRUPACT-II transportation containers be certified by NRC? If so, what is the status of this review?

Mr. Duffy. The Nuclear Regulatory Commission issued on August 30, 1989, a Certificate of Compliance with Federal regulations on WIPP's specially designed TRUPACT-II shipping container.

Mr. Bevill. Identify by group the funding provided to all State and local groups associated with WIPP.

Mr. Duffy. The current estimated funding to be provided in FY 1990 for State and local groups includes: $1.4 million - State of New Mexico Environmental Evaluation Group; $750,000 - State of New Mexico Environmental Improvement Division; and, $1.5 million - Western Governors Association. Funding for the Southern States Energy Board is still under DOE consideration at this time.

DEFENSE WASTE PROCESSING FACILITY

Mr. Bevill. Please describe any outstanding technical issues to be resolved before the DWPF start-up.

Mr. Duffy. We believe that all known DWPF technical issues have been resolved. Cold testing to be started in the fourth quarter of FY 1990 to meet waste compliance requirements may give rise to unforeseen technical issues. As a related issue, we are seeking to identify alternatives to the Consolidated Incinerator Facility (CIF), to meet scheduled hot startup of DWPF. The CIF is needed to process hazardous waste produced by DWPF. Should a suitable alternative not be identified and should the CIF startup be delayed, hot startup of DWPF could also be delayed.

Mr. Bevill. Are any issues remaining to be resolved with other Federal or State agencies?

Mr. Duffy. An industrial wastewater treatment facility permit application has been submitted to the State of South Carolina, for the DWPF, as requested. Regular meetings will be scheduled with the State to address any issues that arise during the processing of the permit application. No problems are anticipated in this regard.

We are currently working with the DOE's Office of Civilian Radioactive Waste Management to satisfy requirements for waste disposal in a Nuclear Regulatory Commission licensed repository. Again, no problems are anticipated.

INCORPORATION IN THE HANFORD WASTE VITRIFICATION PLANT OF LESSONS LEARNED FROM THE DEFENSE WASTE PROCESSING FACILITY

Mr. Bevill. What steps are being taken to insure that HWVP benefits from lessons learned from the DWPF at Savannah River?

Mr. Duffy. A formal program has been in progress since the beginning of the HWVP program in 1983 to ensure that HWVP benefits from lessons learned from the DWPF. The program consists of technical exchange meetings and the participation of a HWVP resident engineer as an observer in the DWPF project office at Savannah River. In addition, DWPF engineers reviewed the HWVP conceptual design.

Technical Exchange Meetings--There have been over 40 such meetings. The meetings, which convene at Savannah River, are based on a formal prearranged agenda and proceedings are documented. These meetings have benefited decisions on vitrification technology, plant design, construction management, and planning for facility startup.

Resident Engineer--The in-depth observations of the resident engineer are summarized in lessons learned reports. Reports have been issued on vitrification building size and layout, project management training, participation of DWPF personnel in HWVP design reviews, and startup of analytical facilities.

CAPITAL EQUIPMENT

Mr. Bevill. Please provide a list of all major items of capital equipment costing more than $1 million in FY 1989, FY 1990, and FY 1991.

Mr. Duffy. I have a list of our major items of capital equipment that I would like to insert into the record.

(The information follows:)

MAJOR ITEMS OF CAPITAL EQUIPMENT
(IN MILLIONS OF DOLLARS)

Site	Item	FY 1989	FY 1990	FY 1991
Hanford	VION NAS 9080 and NAS 9060 (LSIS) Replacement	$ 0	$ 0	$ 6,000
Savannah River	DWPF Process Record Keeping System	0	0	2,100
	DWPF Melter	2,900	9,600	8,000
Total		$ 2,900	$ 9,600	$16,100

CAPITAL EQUIPMENT AT DWPF

Mr. Bevill. What is the total cost of the third melter being purchased for DWPF?

Mr. Duffy. The third melter will cost approximately $25 million from FY 1989 through FY 1992.

CAPITAL EQUIPMENT FOR WASTE OPERATIONS

Mr. Bevill. What types of capital equipment are purchased in this program for waste management operations at Weapons and Nuclear Materials Production Facilities? Why aren't these items considered part of the ongoing operations and funded by the Weapons and Nuclear Materials Production programs?

Mr. Duffy. Capital equipment such as assay, sorting equipment, analytical equipment for characterization instrumentation, treatment equipment, and laboratory equipment to support RCRA analyses is purchased by the Environmental Restoration and Waste Management account. These are related to waste management and therefore are not considered part of the ongoing production operations. The Department has restructured its budget to separately budget and manage all waste management activities under one program account.

ACQUISITION OF TRUPACTS

Mr. Bevill. Will there be a need for purchases of additional TRUPACTS?

Mr. Duffy. Under the current scope of work, no additional TRUPACT-IIs will be required to fulfill the operational transportation needs of WIPP.

Mr. Bevill. What was the total cost of the TRUPACTS?

Mr. Duffy. The total cost of the TRUPACT procurement is $17,240,857.00.

Mr. Bevill. How many have been procured through FY 1990?

Mr. Duffy. A total of 51 TRUPACT-IIs have been procured along with trailers and support equipment. Production has begun and deliveries are scheduled to begin in 1990 and end in mid-1991.

CONSTRUCTION

Mr. Bevill. The following projects are included in the FY 1991 budget with a footnote indicating the TEC, funding profile, and schedule are under review and may increase. For each of these projects, please provide a brief description of the uncertainties or problems which exist:

Mr. Duffy. The following summarizes the problem and uncertainties associated with these construction projects.

89-D-175 HAZARDOUS WASTE/MIXED WASTE FACILITY, SR

The probable increase in TEC is principally attributed to: changes needed to demonstrate compliance with the Resource Conservation and Recovery Act (RCRA) regulations. The facility's classification having been upgraded to a nuclear facility due to a broader application of the DOE Order regarding nuclear facilities and indeterminate costs associated with Environmental Protection Agency's anticipated promulgation of waste treatment standards in May 1990. The reclassification of the facility may result in a 12-18 months delay and approximately $30 million cost increase. Definitive information will be available later this year.

83-D-148 NON-RADIOACTIVE HAZARDOUS WASTE MANAGEMENT, SR

The Consolidated Incinerator Facility (a subproject) may experience TEC increases due to: the possibility that the facility's classification may be upgraded from a low hazardous facility as a result of a safety reassessment to a moderate hazard facility, a schedule compression of 6 months to coincide with need to process Defense Waste Processing Facility (DWPF) waste and meet Lan Disposal Restrictions (LDR) date, implementation of more rigorous quality assurance requirements (NQA-1) and reliance on vendor quotes for estimates

(regulations have caused many vendors to not bid, or significantly increase their bids.)

91-EM-100 ENVIRONMENTAL & MOLECULAR SCIENCE LABORATORY, RL

A firm total estimated cost, funding profile and schedule are being developed as part of the planning and design effort proposed for FY 1991. With that information, the Department will make a decision on whether to proceed with construction and the programmatic sponsor for the project.

HIGH TEMPERATURE SUPERCONDUCTIVITY

Mr. Myers. Please explain why the Department has placed the High Temperature Superconductivity Pilot Centers within the renewable energy programs when related research is also conducted within the Office of Energy Research. How do these efforts differ and what coordination exists between the programs?

Mr. Davis. The government/industry interaction fostered by the pilot centers fits more naturally with the application oriented, frequently cost-shared portion of the renewable energy program than with the fundamental scientific efforts of the Office of Energy Research. The purpose of the Superconductivity Pilot Centers is to promote cooperative research and development between the private sector and the national laboratories. The centers have a broad mandate to pursue superconductivity research in all areas. Collaborative agreements between the national laboratories and industry have been initiated with the objective of fabricating materials and building devices. A broad range of topics are being covered and include magnetic bearings, thin film electronics, conductors from bulk materials and a small electric motor. The Office of Energy Research conducts basic research on the science of superconducting materials. Improved understanding resulting from basic research finds immediate use in the applied effort to fabricate practical coils, cables and other components of electric systems. DOE superconductivity coordination is performed formally by the Energy Materials Coordination Committee, Subcommittee on Superconductivity, and informally through periodic meetings, joint attendance at review meetings, workshops and program briefings, and by exchange of program information, plans, and reports.

WIND ENERGY

Mr. Myers. Will the budget request keep DOE's fundamental wind energy research programs operating and at the same time provide funding for the Advanced Wind Turbine?

Mr. Davis. Yes. Key projects that relate to understanding the unsteady nature of wind turbine aerodynamics in order to better model behavior of fixed pitch airfoils in high winds, improving the designer's understanding of the turbulent wind inflow and the resulting stresses and fatigue impacts, and designing better airfoils and other basic research, would be continued at approximately level funding. The initial thrust of the Advanced Wind Turbine Program includes studies of advanced turbine conceptual designs for which three contracts are now being negotiated. Funding to complete and evaluate these designs is included in our FY 1991 request.

Mr. Myers. Please describe DOE's plans for fundamental wind research and development programs and the Advanced Wind Turbine over the next three fiscal years.

Mr. Davis. The fundamental portion of the program involves research into the wind inflow encountered by single turbines and arrays, the resulting aerodynamic pressures that cause the rotor motion, and the turbine's structural response to that motion. In FY 1991 and later years, I would expect this research to continue, as these are complicated research problems. We have made real progress in these areas. The role of unsteady aerodynamics in behavior of fixed pitch rotors is becoming much better understood. We have

largely completed research in wind turbine wakes and are relying on European experience through the IEA to fill out our data base, and we have supplied structural and fatigue models to industry. We will continue to focus our fundamental research on high priority topics in order to maximize the benefits of Federal research.

U.S. industry needs advanced technology to make wind energy cost-effective in domestic and international markets. The design of a wind turbine is a systems engineering problem in which an error or excessive design margin affects many subsystems. Many of the turbine designs originated in the early 1980s without the benefit of what has been learned in the Federal Program or experienced by industry since then. Consequently, the first stage in the Advanced Wind Turbine Program is a set of conceptual design studies of advanced turbines in order to allow industry to identify those options most promising of reduced cost, improved performance and life time, reduced maintenance and installation, and to examine these options in the context of a systems engineering effort. Three contracts for conceptual design studies are now being negotiated. These studies will be continued and evaluated through FY 1991. Based on the degree of improved performance obtained as a result of those designs, and other factors, the development of one or more advanced turbines will be considered in planning the FY 1992 and future budget requests.

SINGLE APPROPRIATIONS ACCOUNT FOR
ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT

Mr. Myers. What is the rationale for the proposal to restructure the budget and appropriation account for the department's environmental restoration and waste management (EM) activities?

Mr. Duffy. The FY 1991 budget presents, for the first time, a single, focused and unified program which relates directly to the Five-Year Plan. This budget consolidates clean-up and restoration activities previously funded within Defense Programs, Nuclear Energy and Energy Research that are contained in the Five-Year Plan. Uranium enrichment activities will remain in a separate appropriations account due to the nature of the production and sales revenue environment utilized for uranium supply and environment activities. This unified budget presentation should assist in ending the practice of trading off funds for environmental projects with production and other programmatic activities. Establishing a single appropriations account is not intended to change or lessen Congressional oversight of the Five-Year Plan activities. Instead, we consider that this consolidation may assist Congressional oversight by focusing the Five-Year Plan budget request for improved review and examination. A separate appropriations account helps ensure that funds meant for cleanup and environmental restoration will be spent according to the priorities established among competing cleanup projects and not relegated to claim only what remains after DOE production and program needs have been satisfied.

TOTAL REQUEST FOR DOE'S CLEANUP

Mr. Myers. What is the total amount requested for the environmental restoration and waste management activities and how does that compare to the fiscal 1990 appropriated level?

Mr. Duffy. The FY 1991 adjusted budget request of $2.791 billion is $573 million, or 26 percent over the FY 1990 level. This budget continues the rapid acceleration of the cleanup of DOE facilities started by President Bush's allocation of an additional $300 million to the FY 1990 budget request and the Congress's action to appropriate an additional $357 million for FY 1990.

TECHNOLOGY DEVELOPMENT PROGRAM FOR ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT

Mr. Myers. Please explain the research component of the Office of Environmental Restoration and Waste Management (EM) activities and the corresponding budget requests for fiscal year 1991.

Mr. Duffy. The primary mission of the Technology Development Program is to establish and maintain an aggressive national program for applied research, development, demonstration, testing, and evaluation (RDDT&E). This mission supports the Department of Energy's (DOE) 30-year compliance and cleanup goal by (1) establishing the management process for funding technologies at their various stages of development and deployment for better, faster, and more cost-effective interim and permanent solutions to environmental problems; (2) conducting an innovative, aggressive technology development program for waste management, waste minimization, waste treatment, storage, and disposal; (3) developing more effective remediation technology for restoration of contaminated sites and facilities; (4) developing technologies to reduce occupational and public exposure; (5) establishing a coordinated education program involving universities, DOE national laboratories, and industry to train the people needed to address DOE's Environmental Restoration and Waste Management problems; and (6) promoting technology transfer and outreach among the Department, private sector, and other agencies.

Through the Technology Development program, DOE will accelerate needed developments on high-priority problems; i.e., those requiring better, more permanent solutions. Emphasis will be placed on improved or new technology for characterization of sites to determine the magnitude and extent of contamination spread and its physical and chemical nature. Industrial, university, and DOE laboratory methods will be studied for the most capable and effective restoration and treatment techniques which can be applied to a

broad range of DOE site problems. Establishing a separate technology development program provides the focus of scientific talent to effectively screen available and evolving technologies and provide demonstrated and proven methods for use.

The budget request for Technology Development for FY 1991 is $206.0 million, a 12 percent increase over FY 1990.

Mr. Myers. Do the EM research activities include university-based research? If so, please explain and indicate the requested funding levels for fiscal 1991.

Mr. Duffy. The Office of Technology Development will conduct research, development, demonstration, testing, and evaluation in support of the Environmental Restoration and Waste Management (EM) operations. Although many of these activities will be conducted primarily at the Department's national laboratories, efforts have been initiated to expand the use of the valuable research capabilities at universities directed toward the EM mission requirements. Pilot centers for university partnerships have been established in South Carolina and New Mexico with collaborative research activities for teaching/research efforts related to curriculum development, which are estimated to be $3 million in FY 1991. Other university-based research activities supporting EM are expected to be competitively procured following issuance of requests for proposals this spring. Following competition, projects which are awarded to the private sector and universities for FY 1991 could be as much as $20 million.

Mr. Myers. Please explain the relationship, both in organizational and budget terms, between the new office of Environmental Restoration and Waste Management and the existing Office of Environment, Safety and Health?

Mr. Duffy. The Office of Environmental Restoration and Waste Management (EM) is a line office which is established to consolidate environmental cleanup, compliance and waste management activities identified in the Five-Year Plan. EM provides centralized management and planning and focused headquarters' control and validation of cost, schedule and priority of environmental restoration and waste management projects at DOE facilities not actively used for production. EM also administers an aggressive environmental restoration and waste management applied research and technology development program.

The Office of the Assistant Secretary for Environment, Safety and Health (EH) directs its oversight to the implementation of environmental, safety and health policies. EH develops and coordinates Department of Energy policy and guidance, and conducts assessments to assure compliance with applicable laws related to environmental protection, radiation safety, worker safety, and those aspects of public health and safety that deal with epidemiology and radiological protection.

EH is also responsible for inspecting and assessing the effectiveness of the Department's safeguards and security policies, programs, and implementation in the field, and for the safety certification of packages for shipment of DOE radioactive materials.

EH's role is that of an independent overseer of compliance with environment, safety and health requirements. EH establishes DOE health and safety policy EH oversees EM's implementation of its programs.

In terms of budget, EM is responsible for the development and overall execution of those DOE initiatives included in the Five-Year Plan. The EH budget, used to fund its oversight functions, is separate.

RENEWABLE ENERGY BUDGET

Mrs. Boggs. I think everyone welcomes the Administration's renewed recognition of the importance of renewable energy R&D as reflected in this budget request. Please explain the rationale for the very significant increases in research funding for biofuels and photovoltaics while wind energy research has remained basically constant and the ocean energy program has been eliminated.

Mr. Davis. In the evaluation of a new technology there are often opportunities to realize significant advances toward product maturity or market acceptance through a relatively modest but concentrated effort at a certain stage. Similarly, in the parallel evolution of several technologies, there may occur an event, a new requirement, or simply a growing realization that the benefit to be derived from one or a select few of the technologies is more urgently needed. With these tenets in mind, we have reviewed the renewable energy portfolio of activities and made certain priority adjustments.

For example, there is a consensus among the photovoltaics community that concentrated attention at this time on manufacturing process technology can translate recent technical advances into new or significantly improved products and, as a result, strengthen the domestic industry and position it for rapid growth and international competitiveness. In biofuels, the potential for oil displacement and environmental enhancement merits more intensified research and development. These and other initiatives deserve our foremost attention and, where special investment is warranted, should be

assigned appropriate priority. In this process, not all energy options can receive favorable treatment and some may need to be deferred temporarily or, for the current period, eliminated. We have made these choices and have tried to be as objective as possible in doing so.

MUNICIPAL WASTE

Mrs. Boggs. Please describe the nature of the funding request for research on municipal waste combustion. What do you expect to learn from this research?

Mr. Davis. The U.S. produces over 200 million tons of MSW and other wastes that are discarded in landfills each year. This represents an energy potential in direct conversion and recycling of over 2.5 Quads. Currently about 20% of the MSW produced is being used productively. Expanded use is hampered by a lack of comparative energy, environmental, and economic data for energy production, energy conservation and landfilling. In cooperation with EPA, State and local governments, and industry, DOE will undertake research to fill these gaps. For example, research will be initiated on ash management, and new environmental technology such as pelletized refuse-derived fuel will be tested.

BIOMASS

Mrs. Boggs. How does the research program on biomass-derived alcohol fuels differ from work already done in the area of ethanol research?

Mr. Davis. The Department's initiative on ethanol research builds upon and accelerates the current program. The program on biomass-derived alcohol fuels currently focuses on enzymatic hydrolysis and isomerization as the most promising pathway for producing ethanol at a price competitive with gasoline in the mid to long term.

SERI LAB

Mrs. Boggs. You are requesting significant funding for a new laboratory at SERI. What is the current state of facilities at SERI and why is this new facility important?

Mr. Davis. The primary research facilities at SERI are in leased buildings that were originally constructed as office buildings and subsequently converted to laboratory space. They are poorly suited to support current laboratory needs for reasons of design and availability of certain services. From a research viewpoint, large equipment cannot be installed without tearing down and rebuilding exterior walls; the vibration level of the floors is too high to allow critical optical measurements; and the capacity of the building services (electric, water, gas, HVAC) has become inadequate to support research needs. The buildings lack certain newer and more desirable safety systems. The new facility will provide for safe, state-of-the-art experimentation for photovoltaics and material sciences, replacing Building 16 currently leased in the office park.

GEOPRESSURE RESEARCH

Mrs. Boggs. This year's geopressure research budget is down significantly from the FY90 appropriation. Please explain the program you intend to fund with this request.

Mr. Davis. In FY 1991, testing of the Pleasant Boyou well will continue and the hybrid power experiment will be completed. The long-term pressure buildup test at the Gladys McCall site will be completed. During this time, the value of additional scientific testing will be assessed. If such testing would not significantly add to the existing information base, DOE-funded activities at the McCall site will be terminated. At the Hulin site in FY 1991, the well will be shut-in, pending a decision on the value of future testing activities. Supporting research at the universities would continue, but at a somewhat reduced level.

Mrs. Boggs. Please explain the nature of the research conducted at the Gladys McCall well. What would it take to continue a completion program to investigate the changes in the reservoir after extensive brine production? Why is this important?

Mr. Davis. Research conducted at the Gladys McCall well has consisted of long-term flow tests, analyses of the natural gas and aromatic hydrocarbons contained in the geopressured brine, and pressure buildup tests with the well shut-in. During its production testing period the Gladys McCall well produced over 27 million barrels of hot brine and over 600 million cubic feet of methane. Since October 1987 the well has been shut-in for an extended

pressure buildup test, which will aid in defining the productive lifetime of the geopressured reservoir. Upon completion of the buildup test, a comprehensive set of logs will be taken to record changes in the reservoir. These changes should provide useful information about drive mechanisms that can affect reservoir productivity and longevity. This will be completed with current funds.

Mrs. Boggs. What type of testing is planned for the small power plant at the Pleasant Bayou well? What would it take to perform post-production characterization of the reservoir?

Mr. Davis. We plan to operate that plant for most of FY 1990, then in FY 1991 to decommission it, disassemble it, and analyze its parts for wear, corrosion, or other signs of extended use. For technical reasons, the Pleasant Bayou well never has flowed at high rates for extended time periods. Consequently, we believe that any such characterization effort would be of limited scientific value, and have made no plans for such work.

Mrs. Boggs. The Hulin well was reworked using funds available from the sale of equipment from the Baca Project. Are there any funds remaining from the sale of the Baca equipment? What are your plans for using any remaining funds?

Mr. Davis. Prior legislation directed the Department to use the funds available from the sale of equipment of the Baca Project to clean out the Hulin well. We have used part of these funds to remove the old production tubing and completion materials from the well. In addition, we have flowed

the well for three-day periods and measured the brine temperature, pressure and chemical composition. The well is now in a safe operating condition. There are about $2.3 million remaining from the sale of equipment from the Baca Project, which could be used to defray the costs associated with additional testing. After a thorough evaluation of the flow data it is our intent to construct surface facilities for additional flow tests to complete our activities at the site. This test will complete the cleanout process, confirm the integrity of the wellbore and establish the production characteristics of a deeply buried geopressured reservoir. This information will be useful in demonstrating the viability of using reconfigured oil and gas wells to tap the geopressured resource.

Mrs. Boggs. What would it cost to complete re-tooling of the Hulin well and building a surface test facility?

Mr. Davis. The Hulin well has been recompleted with three and one-half inch tubing from the geopressured reservoir to the surface. A surface test facility suitable for conducting flow tests could be built with the remaining funds from the sale of the Baca equipment.

Mrs. Boggs. Would this budget request permit study of the nature and potential of deep reservoirs, such as the one at the Hulin well? What value would there be for this type of research?

Mr. Davis. The budget request will permit a short-term flow test at the Hulin site, which will increase our knowledge of the nature and potential of deep geopressured reservoirs, and help improve predictions of reservoir size

and flow characteristics. This information will be valuable to industry in making investment decisions pertaining to the potential exploitation of geopressured resources.

Mrs. Boggs. I understand there is some interest in utilizing energy from the Hulin well for local power production as well as for agricultural and aquacultural purposes. Please describe these proposals.

Mr. Davis. An Industrial Consortium for the Utilization of the Geopressured-Geothermal Resource has been formed to determine the technical and financial feasibility of various options. Four major areas for industrial participation were identified and discussed: Thermal Enhanced Oil Recovery, Aquacultural and Agricultural, Hydraulic and Thermal Conversion to Electricity, and Use of Supercritical Water in Detoxification of Pollutants.

Mrs. Boggs. Please submit to the Subcommittee a brief report, summarizing the nature of the geopressure resource, the history of research in this area (including annual funding levels), any significant findings achieved as a result of this research, and the ultimate goal of geopressure research should adequate funding be available, indicating where this research program should be in five years. In addition, please discuss the interest and/or involvement of major energy companies in geopressure research.

Mr. Davis. Geopressured geothermal energy is unique, consisting of three forms of energy contained in the water (usually between 300°F to 450°F), natural gas dissolved in the water, and hydraulic energy in the form of high pressure.

Geopressured geothermal sandstone aquifers exist at depths below about 8,000 - 12,000 ft. along a broad band of Texas/Louisiana coastline. Pressure gradients range to more than twice the hydrostatic gradient. Temperatures range upward from 120°F; figures in excess of 500°F have been recorded. Temperatures tend to be higher toward the western end of the resource area, but permeabilities are higher toward the eastern end.

Research and field testing began in 1974, under the auspices of DOE and its predecessor agencies, to provide the scientific and technological base for determining technical feasibility. Once the resource base was established and research in geology and engineering had developed methods for field testing, DOE initiated the Wells of Opportunity Program, that is, testing wells drilled through geopressured zones by industry in search of petroleum or natural gas. These wells were taken over and flow tested for short periods to determine flow rates, natural gas content, brine chemistry, reservoir pressures, and temperatures.

The Wells of Opportunity Program began in 1977. Short-term flow tests were conducted at nine wells. These tests confirmed that dissolved natural gas was present at or near saturation. Between 1979 and 1982, four new design wells were specifically drilled and instrumented for long-term performance tests, two of which have completed testing. The remaining two, the Pleasant Bayou well located in Texas and the Gladys McCall well located in Louisiana, along with the Hulin well which was acquired in 1983 are currently utilized by the Program.

The funding for the program is shown in a table which I would like to submit for the record. (The information follows:)

Geopressured Fiscal Year Funding
(In Millions of Dollars)

76	TQ	77	78	79	80	81	82	83	84	85	86
.3	.8	6.6	16.5	27.7	36.0	31.9	16.7	8.4	5.0	5.4	4.4

87	88	89	90
4.0	4.9	10.3	5.9

The ultimate objective of the geopressured program is to gather sufficient data and develop theories which will enable industry to understand geopressured reservoirs and predict their longevity and flow characteristics. The department hopes to achieve its current programmatic objectives within the next five years.

An industrial consortium group is looking into various options for utilizing the geopressure resource. With respect to major oil companies, Shell Oil Company, Texaco, and Exxon have expressed interest in the Hulin well. Texaco has offered assistance in designing and carrying out a testing program at the Hulin site. During the resource assessment phase of the Program, numerous oil companies provided proprietary well and seismic data to geopressured researchers at Gulf Coast universities.

Natural Gas Research

Mrs. Boggs: Please describe the Department's Research Plan for Natural Gas.

Mr. Gentile: The research activities described in the five-year Research Plan for Natural Gas are divided into three groups near-term (less than 5 years), mid-term (5 - 10 years) and long-term (greater than 10 years) time frames. The time frames represent when the research can be expected to yield results that are useful in the market place. While research activities with near-term payoff are emphasized in the early stages of the plan, some activities with mid- and longer term payoff are also planned for FY 1991 to ensure timely contributions from the research results. Near-term activities focus on conventional resources and the application of horizontal well technology to unconventional gas resources. Conventional gas research activities include data base consolidation, reservoir classification studies, secondary gas recovery efforts and gas atlas efforts. Activities with mid-term payoff focus on the low permeability unconventional gas resources with emphasis on developing advanced stimulation concepts. The speculative resources, which include gas hydrates, gas from deep sediments and the gas potential of new plays, represent the longer term portion of the gas plan. Immediate efforts that will have long term benefits include resource assessment and the evaluation and rankings of new play areas.

Mrs. Boggs: I understand that geopressure gas resource of the western and central Gulf of Mexico Basin has the potential for 5700 TCF of dissolved gas reserves. Does the Department's natural gas research program plan to investigate this very significant resource?

Mr. Gentile: At present there are no plans by Fossil Energy to investigate geopressured methane since geopressured methane research is presently conducted by the Department's Office of Conservation and Renewable Energy, in the Geothermal Energy program.

Mrs. Boggs: If so, please describe the scope of cooperative research to be undertaken between the Office of Fossil Energy and the Geothermal Technology Division.

Mr. Gentile: There are no specific plans at present for cooperative gas research efforts with the Geothermal Technology Division concerning geopressurized methane research. However, it should be noted that the Office of Geoscience Research, which is part of Fossil Energy, manages and directs the activities of the Hydrocarbon Geoscience Research Coordinating Committee. The Coordinating Committee includes any organization in DOE that has an interest in Hydrocarbon Geoscience which includes the Office of Conservation and Renewable Energy. Through the Coordinating Committee, Fossil Energy stays informed of developments in Geopressured Reservoir Research performed by the Geothermal Technology Division. Should research projects arise that will be of mutual benefit to both parties, cooperative efforts will be given serious consideration.

Mrs. Boggs: Yesterday I asked Admiral Watkins about a research proposal submitted by the State of Louisiana to investigate the use of air-transportable drilling systems for use in Louisiana's coastal wetlands. Some 80% of the State's remaining petroleum resources are thought to lie under those wetlands. I understand this proposal has been referred to the Morgantown Energy Technology Center. Can you give a schedule for evaluation and action on this proposal? Since this proposal has been endorsed by the entire Louisiana Congressional delegation, I trust you will give it your personal attention.

Mr. Gentile: We have reviewed the proposal and the evaluation was completed on March 9, 1990. A notification of action on the proposal was issued on March 15, 1990 and I have requested my staff to keep me informed on the status.

SUBMISSION OF PROPOSAL TO TULANE UNIVERSITY

Mrs. Boggs. I would also appreciate your submitting a status report on a proposed "Comparative Study of Coastal Erosion Control/Reversal Devices for Areas Impacted by Oil and Gas Activities" which has been submitted by Tulane and Xavier Universities.

Mr. Gentile. The proposal was hand-delivered to the Metairie Site Office on March 7, 1990. MSO will transmit copies to the Pittsburgh Energy Technology Center for Administrative processing. The entire Administrative and Technical Evaluation Process will take at least 60 days before a notice of acceptance or rejection is delivered.

FY 1991 DOE SOLAR AND RENEWABLES

Mrs. Boggs. The Department's waste management and environmental restoration program is very ambitious but very necessary. Are you taking advantage of university-based hazardous waste research facilities?

Mr. Duffy. The Office of Technology Development will indeed conduct research, development, demonstration, testing, and evaluation in support of Environmental Restoration and Waste Management (EM) operations. We will take advantage of university-based hazardous waste research facilities. Pilot partnerships have been established in South Carolina and New Mexico with collaborative research activities for teaching/research efforts on curriculum development. Other university-based research activities supporting EM are expected to be competitively procured following issuance of requests for proposals this spring.

ETHANOL AS AN ALTERNATIVE FUEL

Mrs. Smith. One of the primary themes emphasized by those who offered testimony was that DOE should work to implement private, state, and public sector cooperative research and demonstration programs to move ethyl tertiary butyl ether (ETBE) forward. What plans has DOE developed to respond to this input to begin to initiate such research and demonstration programs?

Mr. Davis. The National Energy Strategy process has been collecting testimony from many people around the Nation at a series of hearings. The Department must critically review, analyze and prioritize the many issues raised and form policy options that will determine where resources can be spent most beneficially. Meanwhile, in carrying out the Alternative Motor Fuels Act of 1988, the Department has begun to assess the current state of development of all alternative fuels under the newly formed Alternative Fuels Commission. Further the Department successfully urged the Treasury to support extension of the highway tax credit and blenders tax exemption to the biomass-based ethanol used to produce ETBE, an octane enhancer.

Mrs. Smith. ETBE appears to be an excellent alternative to help reduce the level of particulate emissions from diesel fuel. Given the substantial positive effects that such reductions could provide, has DOE developed any programs to put more emphasis on this area.

Mr. Davis. The Department has launched an initiative and is taking other actions to emphasize and address both production and utilization issues of fuel ethanol. In addition the Department interceded with EPA to insure that a study they initiated on methyl tertiary butyl ether (MTBE) included ETBE. It is correct that ETBE will reduce particulate emissions from diesel fuel. Unfortunately, both ETBE and MTBE reduce the driveability of diesel engine powered vehicles to the point that they are not viable blending agents. However, ethanol also reduces emissions from diesel without causing driveability problems and is being explored as a blending agent.

Mrs. Smith. Please provide for the record Department allocations for study, research, development, and other expense related to the development of ethanol as a renewable energy source for FY 1991, preferably in a table showing comparisons for the past 10 years or other time-frame to show context of our national government's involvement in this field?

Mr. Davis. I would be pleased to provide such a Table as an insert to the record.

TABLE

Renewable Ethanol Research and Development Funding

($ in millions)

Fiscal Year	Amount
1981	$12.0
1982	10.0
1983	5.0
1984	6.9
1985	4.1
1986	4.1
1987	3.9
1988	3.1
1989	2.4
1990*	2.6
1991 request	10.8

* A pending reprogramming request includes $2.0 in additional funds for ethanol R&D which would bring the total to $4.6M.

Mrs. Smith. Basically, what maximum role do you envision for ethanol both as an essential fuel and as a way to reduce air pollution in certain urban areas?

Mr. Davis. DOE has selected ethanol from biomass as one of its recently announced initiatives. That program focuses on using nonfood cellulosic feedstocks instead of sugar or grain, thus eliminating any conflict between fuel and food. Further, we are working on the development of fast-growing trees and grasses that have the promise to increase the output of ethanol per acre and provide alterative crops for farmers. The new conversion technology we are researching has the promise to reduce the cost of biomass-ethanol dramatically. As a blend, ethanol has already shown that it can reduce CO emissions, particularly in older model cars, in cities such as Denver. ETBE is expected to produce similar results. Neat ethanol has the potential to provide even lower emissions.

DROUGHT IMPACT ON POWER GENERATION

Mrs. Smith. I have already asked Secretary Watkins about drought effects, the worst-case scenarios, and what the department may be doing to address problems arising from drought, now in its fourth year in the west. How concerned should we as a region and as a nation be about the continuing drought's effects on hydroelectric power generation? Energy is one of the largest costs for our food and fiber production. If hydroelectric power grows scarcer, the cost of all energy tends to rise.

Mr. Davis. The Department of Energy is very concerned with the impact any drought situation may have on hydroelectric power generation.

Mrs. Smith. Please provide now or for the record a thorough discussion of the drought's impact on the nation's hydroelectric power production to date, the worst-case scenario for FY 1990 and FY 1991, and what plans or measures the Department of Energy is making or contemplated to offset these effects. What are the major economic impacts of the drought, both short-term and long-term.

Mr. Davis. Hydroelectric power production throughout the country has been affected by drought conditions in recent years. I have asked the Administrators of the five power marketing administrations to respond, for the record, with the information you have requested. They are well aware of the impact of drought conditions in their specific power marketing areas of the country. (The information follows:)

ALASKA POWER ADMINISTRATION

Alaskan hydroelectric projects have not experienced drought conditions in recent years. Thus far in FY 1990, water supply conditions are favorable. Given present storage levels, curtailment of power production in 1990 and 1991 due to drought conditions is quite unlikely.

BONNEVILLE POWER ADMINISTRATION

The Pacific Northwest (PNW) suffered through three years of drought, 1986-87, 1987-88, and 1988-89. In these years, the volume of runoff measured 71%, 68%, and 86% of average, respectively. As a result of these low water years, the Bonneville Power Administration (BPA) made no sales of nonfirm energy except during the fish flow operation period. BPA also purchased substantial quantities of energy (1) in place of operating high cost resources and (2) to allow it to serve the nonfirm portion of the Direct Service Industries. The lack of nonfirm sales plus the purchase of resources reduced BPA's revenues below the forecasts of net revenue. There has been no impact on BPA's Treasury payments. All Treasury payments have been made as projected during the last six fiscal years and we are confident that we will make our full planned payment to the Treasury at the end of FY 1990.

During FY 1990, the PNW is not experiencing a drought. The current forecast of volume runoff is 92% of average. BPA is currently in the nonfirm market selling energy. We do not expect any short-term impacts because of this year's operation. We do not have any knowledge regarding the runoff in FY 1991.

The long term economic impacts of the three year drought are in two areas. The first results from the reaction of the Corps of Engineers (Corps) and the Bureau of Reclamation (Bureau) to concerns of their local constituencies. The reservoirs of both agencies have not been as usable as these constituencies would like. Both agencies have placed new limitations on the use of their reservoirs which will have a potential long-term financial impact on BPA. To the extent that the reservoirs are not usable for power production, BPA must purchase high cost replacement resources. The second long-term impact relates to the first. To the extent that the multi-year drought results in different operations on the Columbia River system, BPA will have to incorporate any resultant needs for greater financial risk protection in setting its electric rates. The majority of the generating utilities of the Pacific Northwest, plus the Bonneville Power Administration, the Corps, and the Bureau, have signed a contract which guides the operation of the reservoirs of the signatories. No other special arrangements are necessary between BPA and the Corps or the Bureau.

SOUTHEASTERN POWER ADMINISTRATION

The projects in the southeastern states have recovered from the prolonged drought of the past several years. During the drought period of 1986-1989, Southeastern Power Administration purchased $26.5 million in replacement energy to meet minimum contractual quantities. During FY 1990, project operations and hydrological conditions are expected to be favorable, with a near normal or better water year. During FY 1989, Southeastern implemented a rate increase which had not been anticipated and additional rate increases are planned for FY 1991 to insure systems repayment in a timely manner.

SOUTHWESTERN POWER ADMINISTRATION

As a result of significantly above-normal rainfall during the months of January and February, 1990, the projects whose hydroelectric power output is marketed by the Southwestern Power Administration (SWPA) have recovered from the effects of drought conditions during 1988 and 1989. Although periods extremely low rainfall occurred during each of those years, they were of relatively short duration and were followed by periods of abnormally high rainfall. As a result, total hydroelectric energy production during both years were slightly above the long-term average.

Should rainfall in the SWPA region fall to levels experienced during the most critical long-term drought of record, SWPA would be required to acquire about 550,000,000 kilowatthours (kWh) of energy from other sources in order to meet contractual obligations during FY 1990 and FY 1991. We estimate that over half of the energy would be purchased at a cost of about $9 million, with the balance being received though energy banking arrangements.

WESTERN AREA POWER ADMINISTRATION

As of March 1, 1990, drought conditions continue to prevail throughout the Western Area Power Administration's (WAPA) service area resulting in below-normal reservoir storage in the Missouri, Colorado, and Sacramento river basins. Federal hydroelectric generation was about 80 percent of normal in FY 1989. Current predictions indicate that hydroelectric generation may be as low as 79 percent of normal in FY 1990, even with normal streamflow, simply because of the need to refill reservoirs. WAPA's power purchases are directly related to generation levels, which are dependent on water conditions. If drought conditions continue through the remainder of FY 1990, estimated power purchases could equal or exceed the FY 1989 high of 8.34 billion kilowatthours. Non-Federal power generation capabilities should be sufficient to allow WAPA to purchase any power needed to meet contractual commitments.

Alternative financing arrangements, such as net billing, bill crediting, reimbursable authority, and non-appropriation transfers are used to fund a large portion of WAPA's purchase power and wheeling program activity in FY 1991, thereby, minimizing appropriations requests. In FY 1990, Congress authorized WAPA to use its continuing fund to defray power and wheeling expenses during periods of below-normal hydropower generation, as an alternative to requesting supplemental appropriations. WAPA is using the continuing fund to supplement power purchases for the Pick-Sloan Missouri Basin Program and might use it for the Colorado River Storage Project.

Mrs. Smith. Does the Department work with other agencies, such as the Corps of Engineers and the Bureau of Reclamation, in addressing drought problems? What has been the gist of any recent or current discussions with these agencies?

Mr. Davis. The Department of Energy, as a member of the Interagency Drought Policy Committee, continues to work with a variety of other agencies, including the U.S. Army Corps of Engineers (Corps) and the Bureau of Reclamation (Bureau), to address drought situations. The power marketing administrations (PMAs) work closely with the appropriate regional contacts of those agencies (Corps - all PMAs; Bureau - Bonneville and Western Area Power Administrations only). I have asked the PMA Administrators to respond, for the record, with a summary of recent drought-related discussions or activities affecting their marketing area. (The information follows:)

DROUGHT ACTIVITIES

The Bonneville Power Administration (BPA), the Corps, the Bureau, and a majority of the generating utilities of the Pacific Northwest, have signed a contract which guides the operation of the reservoirs of the signatories. Also, as mentioned above, the Corps and the Bureau have added new limitations to their reservoir operations as a result of the drought. There is also a long-term process now underway in which all three agencies, BPA, Corps, and the Bureau, are analyzing the operation of the reservoir system and determining the tradeoffs between the power operation and the limitations on reservoir operation due to nonpower needs.

The Southeastern Power Administration (SEPA) continues to work with the Corps of Engineers in addressing drought problems. A degree of concern is present should the Corps implement their "Water Control and Drought Contingency Plan" in the event streamflow conditions fall below normal, causing SEPA to purchase replacement energy to meet minimum contractual quantities.

In the Southwestern Power Administration (SWPA) marketing area, the Corps of Engineers is in the process of developing drought contigency operating plans for each of their projects. SWPA has been provided an opportunity to review and comment on those plans. In addition, SWPA is developing a plan for managing hydroelectric power operations during drought conditions. That plan includes the use of rainfall and soil moisture data to forecast an impending drought. The SWPA plan is intended to insure that hydroelectric power operations are adjusted to reflect anticipated drought conditions rather in reaction to existing drought conditions as provided in the Corps' drought

contigency plan. SWPA has also indicated an interest in participating in the Corps' National Water Management During Drought Study being undertaken by the Institute for Water Resources.

The Western Area Power Administration (WAPA) coordinates daily with both the Corps and the Bureau in operating the river systems in WAPA's service area. The most notable drought-related coordination, however, has been on the Missouri River due to the intense interest of the Governors of the Upper Missouri River Basin states. WAPA contributed to the Corps' recently-released "Plan of Study for the Review and Update of the Missouri River Main Steam Master Water Control Manual" and plans to stay involved as the study progresses.

COORDINATION WITH ENVIRONMENTAL GROUPS

Mrs. Smith. I have some questions about your No. 1 priority, as outlined in the Secretary's testimony yesterday: your five-year plan for environmental restoration and waste management at our military weapons factories, with the explicit goal of resuming nuclear weapons production. Your testimony also gives high priority to the civilian nuclear waste disposal problems. Has the Department of Energy been working with national environmental groups, such as the Audubon Society, Sierra Club, National Wildlife Federation, and environmental and preservationist groups for their suggestions and counsel with respect to nuclear waste? If so, what is the gist of that advice?

Mr. Duffy. The Department has sought and will continue to seek comments and suggestions from national environmental groups such as the Audubon Society, Sierra Club and National Wildlife Federation. Their comments on Environmental Impact Statements on nuclear waste matters are routinely requested and addressed.

The Department is currently in the process of updating the Five-Year Plan for Environmental Restoration and Waste Management. We are planning to meet with representatives from special interest groups to discuss the Plan and receive input on the issues identified in the Plan. Representatives from the various national environmental organizations will be invited to participate in this process and provide comments.

The Department has also sought input from representatives of national environmental groups such as the ones mentioned above in its ongoing effort to develop a national prioritization system for DOE environmental restoration and waste management activities. While efforts to date have focused on understanding the Department's prioritization methodology as applied to past budgets, reaction to the development of a new prioritization methodology has been very supportive.

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Mrs. Smith. Have they suggested that they might contribute money and staff in trying to help you with your effort? Have they been asking you for money to help you carry out your environmental programs?

Mr. Duffy. Interaction with national environmental groups by the Department in the review of last year's Five-Year Plan and in the development of a national prioritization system has not elicited any offers for contribution of money or staff. These groups have consistently stated their support for the review and development efforts and their desire to continue to be involved. Travel costs and per diem associated with their travel to attend scheduled review meetings is paid for by the Department. To date, the Department has not received any other requests for money to continue their participation.

COOPERATING WITH STATES

Mrs. Smith. How have the states and local environmental and health agencies reacted to your new policy of "openness" with respect to the military nuclear problems and facilities?

Mr. Duffy. State and local organizations appear pleased with the Department's policy of openness but remain skeptical. The Department needs to take additional steps, in some cases, to assure that the policy of openness is fully implemented. We are committed to make that happen. Over time, these groups will gain more confidence and trust in the Department and its initiatives.

Mrs. Smith. Are the states demanding payments to reach agreements with DOE in its efforts to comply with state and local environmental and health laws? Are these amounts one-time payments or are they likely to grow in scope?

Mr. Duffy. States have identified a need for resources to accomplish the oversight of activities and the review and approval of documents and planned actions included in Interagency Agreements which are in place or are being negotiated. States have made this funding a prerequisite to execution of the Interagency Agreement. The Department has supported these payments for activities that will compliment, rather than duplicate those of the Department. State payments have been established as recurring yearly expenses. These payments are likely to increase over time for the foreseeable future as the States gain experience and are able to refine cost estimates and as the amount of cleanup activity increases, requiring a larger oversight commitment and additional resources to review and approve required documents and actions.

CLEAN AIR ACT

Mrs. Smith. I wish to reiterate my question yesterday to Secretary Watkins about my growing concern about the Clean Air Act Amendments of 1989. If current Clean Air Act Amendments as being considered by the Senate were enacted as law, how much would overall energy costs rise or fall as a result of implementation in both short-term and long-term?

Ms. Stuntz. The Department of Energy has not developed independent cost estimates on the short- and long-term energy costs of the compromise Clean Air Act amendments as developed by the Administration and Senate leadership. Overall cost estimates were developed for the Administration proposal and the Senate Committee on Environment and Public Works proposal, S. 1630. EPA/ICF estimated that, on a national basis, the President's proposed acid rain legislation would increase electricity rates by no more than 2 percent with regional increases up to 5 percent. Due to its more stringent NO_x provisions, S. 1630 would result in additional rate increases.

There has not been sufficient time to develop new cost estimates for the short- and long-term energy price impacts of the recent compromise between the Administration and Senate leadership.

RENEWABLE ENERGY PROGRAMS

Mr. Fazio. Mr. Davis, in general, I am very pleased with the level of support that your department and the administration have given the renewable energy budget. It represents a healthy increase over FY 90 (8 percent) and a dramatic increase over the budget request this Committee received for renewables last year (78 percent). I am particularly pleased to see the emphasis on electric power generation and the healthy increase for photovoltaics ($43.6 million requested in FY 91, compared to $34.7 million appropriated in FY 90). Nonetheless, I have four major concerns that I wanted to raise with you regarding the renewable energy programs.

PHOTOVOLTAICS

Mr. Fazio. The budget for photovoltaics includes $9 million to begin a cooperative program with industry to reduce the cost of manufacturing photovoltaic systems. We are all supportive of your new emphasis on commercialization, and this Committee will certainly be supportive of your efforts to reduce the time required to transfer photovoltaic technology from the laboratory to the private sector.

But where is the emphasis going to be placed? Is the core of this effort going to fund industry to commercialize the technology, or will most of the monies be funneled to the national laboratories to help the technology transfer on their end of the pipeline?

Mr. Davis. The Photovoltaic Manufacturing Technology project will look to industry as the principal performer of the research expected to lead to improved manufacturing technology, reduced manufacturing costs, and increased module manufacturing capacity and commercialization. The Department of Energy (DOE) expects that about 90% of the funding will go to industrial and other non-DOE contractors.

Mr. Fazio. I think the industry is concerned that the commercialization goals that you have set for this program will not be achieved unless the focus is on industry, with support from the laboratories on an as needed basis. What is your intent?

Mr. Davis. The DOE Photovoltaic Manufacturing Technology project plans that the PV manufacturing industries will have the major role (and funding) for identifying the module manufacturing research needs and in carrying them out. The two DOE laboratories (the Solar Energy Research Institute and the Sandia Laboratories) assisting the DOE photovoltaic program will assume a low-profile responsibility for planning and carrying out procurements and for administrative and technical overview of the resulting contracts. These DOE laboratory functions are expected to require less than 10% of the project funds. The major part of the project's funds will be directed to contracts with industry for solving company-specific manufacturing problems and with industry groups and other non-DOE organizations for solving generic issues. If an industry/DOE consensus develops around the need for the special research capabilities or facilities at the national laboratories, a small fraction of the funding might be allocated for such work. In any case, the base DOE

program of contracted and in-house research will be supporting the overall manufacturing technology project.

Mr. Fazio. One other thing concerns me about your manufacturing initiative. From the budget justification material there is no evidence that you intend to require the products that will be promoted through your manufacturing initiative will face some stringent field tests. Before we spend millions of dollars making engineering and manufacturing improvements to accelerate delivery of a product to the market place, we need to ensure that it works, and works in the field as well as it works in the laboratory.

One way to do this would be to require that 20 kilowatts of the technology are produced and tested at PVUSA, SERI or Sandia to ensure that the product we are going to produce is as reliable and efficient in the field as it is in the laboratory.

I think it is imperative that we test these technologies in the field and PVUSA, for one, has the capacity to run these qualification tests. Are field qualification tests part of this program, and, if not, why?

Mr. Davis. Reliability assessments and field qualification testing of modules emerging from the manufacturing initiative are a part of this program and will be included in the multiple-year industry contracts. However, the main thrust of this project is to accomplish the research leading to manufacturing technology improvements and not to the funding of manufacturing lines themselves. It would be expected that new module technologies would

undergo extensive system testing after a new or improved manufacturing line is established.

SOLAR THERMAL/CENTRAL RECEIVER TECHNOLOGY

Mr. Fazio. Mr. Davis, while the solar trough technology that came from DOE's program in the 1970s is now commercialized in California, I am concerned about DOE's plans in the solar thermal electric area which has funded R&D in solar dish/engine and central receiver technology. I know industry is concerned that DOE may disband R&D efforts on solar dish/engine technologies; I understand DOE has put three joint ventures with Cummins, Westinghouse and John Deere on hold.

And, I am personally concerned about the direction we are taking on central receiver technology. We have spent more than a hundred million dollars developing this technology; we built Solar 1; and we are simply leaving that technology behind. Industry is still interested in it. U.S. companies are intending to join some of our competitors in a 40 megawatt central receiver project in Jordan. But it looks to me like we are simply abandoning power generation with central receivers, and that we will be content to let our competitors develop the technology and reap the benefits of our past investments.

Does the Department intend to finish its work to commercialize these technologies or continue this research at a meaningful level?

Mr. Davis. The commercial success of the solar trough technology in California is very gratifying, and indicative to me that advanced solar thermal electric systems should be able to penetrate the peaking/intermediate electric marketplace after these systems are field tested.

The Department is developing stretched membrane dishes, advanced high efficiency and reliable reflux receivers, and free piston Stirling engines for dish/Stirling systems. The Department expects to complete the reflux receiver, dish and free piston Stirling engine developments over the next three years. In response to a Request for Information, the industry has indicated that they are interested in commercializing this technology, and the Department plans to issue a Request for Proposal for joint ventures to field test a number of each contractor's dish/Stirling systems. The program was developed in close concert with the industry, and the technology has attracted major new companies interested in developing dish/Stirling systems for remote niche markets and subsequently for utility applications.

Central receiver technology can utilize thermal storage, which permits this technology to be considered for intermediate electric power generation. The Department continues to develop molten salt systems as a highly efficient storage system, an option that also decouples the performance of the system from the transient influence of clouds. The Department will soon conclude a very successful stretched membrane heliostat program under which two contractors will fabricate and test two prototypes. The optical performances of these systems were demonstrated to be equivalent to glass metal technology. The Department has concluded tests on a 5 MWe molten salt receiver, and is currently completing tests on prototype pumps and valves. Packing valve

materials have now successfully operated for more than 1800 hours, which is considered good for commercial plant operation. In response to the Request for Information mentioned earlier, an industrial consortium did respond, indicating an interest in converting Solar 1 to a molten salt system. The Department plans to issue a Request for Proposal for joint venture field system experiments to which industry can respond for solar thermal systems with potential applications in the late 1990s. The conversion of Solar 1 to molten salt could be a candidate project for consideration in that solicitation. If funded, it would be a candidate for the joint venture section of Public Law 101-218 which provides $2.4 million per year for FY 1991, FY 1992 and FY 1993 for such a project.

GEOTHERMAL ENERGY

Mr. Fazio. Geothermal sources provides 6 percent of all electricity produced in California. The overall funding level for the Geothermal Program is only $18 million; this could sensibly be increased by say 50 percent which would significantly speedup resolution of technical problems and increase the viability of geothermal power production.

As outlined in DOE's budget justification, Geothermal Energy already produces a significant amount of electricity within the U.S. In addition to being domestically produced, geothermal energy is relatively benign environmentally and thus it makes good sense to continue to develop geothermal sources. However, the DOE'S budget request for the Geothermal Energy Program is only $18 million for FY 91 and this request is down slightly from FY 90.

Furthermore, the royalty revenues from geothermal power generated on Federal land now exceed expenditures under DOE's geothermal program.

First, what are the current royalty revenues from geothermal power generated on Federal lands, how are these revenues projected to increase over the next few years, and how are they allocated?

Mr. Davis. Total geothermal royalty revenues for fiscal year 1989 were $13.7 million. This figure represents a reduction from the high in fiscal year 1986 of $15.8 million, which is due to reduced steam prices at The Geysers, which are tied to the prevailing cost of oil and other fuels used in California for power generation. Although market forces will continue to determine the direction of The Geysers royalties, increases from other areas can be expected as additional capacity comes on line on federal acreage. According to section 317 of the Federal Land Policy and Management Act of 1976, monies from geothermal leasing are distributed as follows: 50% to the state of origin; 40% to the Land and Water Conservation Fund; and 10% to the general treasury.

Mr. Fazio. Second, given the advantages of geothermal power, it makes sense for the U.S. to continue to develop this resource. Looking to the longer term, I am concerned that DOE is proposed to completely eliminate one of the longer-term research and development efforts -- the magma energy project -- and proposed reducing the funding for another -- the geopressurized research program -- by about 50 percent.

Magma is an enormous geothermal resource. The U.S. Geological Survey, in 1975, estimated the magma resource base at between 50,000 and 500,000 Quads of thermal energy -- that's 650 to 6,500 times the total annual U.S. energy consumption.

Isn't this short-term focus penny wise and pound foolish - that is, shouldn't we continue these longer-term research and development projects, particularly in light of the enormous potential of magma as well as the growing royalties from geothermal production of federal lands?

Mr. Davis. Of the geothermal resources, magma energy is the farthest from commercial development, and will require a very long research program. On the other hand, hydrothermal resources currently offer significant deployment potential in the West that could be developed in the short to mid term to meet emerging electric power needs. Therefore, the Department has focused its research efforts on hydrothermal projects identified by industry as having higher priority for development. Not only will hydrothermal development contribute to the Nation's competitiveness, but it will leverage limited R&D government dollars through industry cost-sharing activities. A strengthened technology and industry base in hydrothermal will support subsequent technology development for longer-term geothermal resources.

Mr. Fazio. Third, the Geysers geothermal field, the largest in the world, has recently begun to suffer unexpected declines in steam production and troublesome increases in corrosion of facilities caused by the geothermal fluids. Part of the $4 million in reservoir technology requested for FY 91 addresses these problems. However, given the importance of The Geysers

geothermal field (produces 2,000 megawatts of electricity), the seriousness of the problems at The Geysers, and the applicability of corrective actions to other geothermal production facilities, this level of funding appears very inadequate. Specifically, what portion of the $4 million initiative for hydrothermal R&D will address The Geysers particular problems? Are these resources adequate to find a solution to the problems at The Geysers?

Mr. Davis. During Fiscal Year 1991, approximately $1,500,000 of the geothermal reservoir technology funding will be directed to the serious problems at The Geysers geothermal field. This is a significant increase from the $1,000,000 of FY 1990 funding directed to The Geysers problems. These financial resources are believed to be adequate to find a solution to the problems if they are matched through cost-sharing from the geothermal industry. A geothermal industry consortium, the Geothermal Technology Organization, exists for the purpose of cost-sharing research with the Department of Energy. Through this consortium, the geothermal operating companies at The Geysers may solicit and select research proposals for joint funding with DOE. One seismic research project at The Geysers, funded in this way, has been completed.

Mr. Fazio. Fourth, it is my understanding that there is about $5 million remaining in the Geothermal Resources Development Fund, a fund which was created to act as a reserve against possible defaults from geothermal development loans guaranteed by DOE. However, there are no outstanding loan guarantees which require the reserve. If so, wouldn't it make sense to apply these funds to augment the reservoir technology and other practical, production-oriented research programs?

Mr. Davis. While it is true that there are no outstanding loan guarantees, there is still one defaulted project in a work-out mode. This project requires careful monitoring and supervision, entailing legal, analytical and other expenses, which must be paid for out of the fund. Furthermore, until the work-out is complete, there is always the possibility of a failure of the project, which could entail substantial liquidation expenses.

In addition, another defaulted project is in litigation, and legal expenses are being incurred in order to protect the Department's interests. Accordingly, we believe it is prudent to retain funds in this account to meet these expenses.

WIND ENERGY

Mr. Fazio. Perhaps the greatest weakness in the renewable energy budget is the proposed budget for wind energy research and development. Last year, Congress appropriated $9.35 million for wind energy and added $1 million to begin work on the Advanced Wind Turbine program. This year, however, you have proposed only $8.6 million for wind energy R&D. That amount would barely keep DOE's fundamental research program operating, and would seem to kill the Advanced Wind Turbine program. What is your intent for the Advanced Wind Turbine program? Do you intend to continue the program in FY 1991, and, if so, at what level?

Mr. Davis. The FY 1991 budget request supports the Advanced Wind Turbine program. The initial phase of the program consists of a number of conceptual design studies of advanced turbines. Although the wind turbine technology now being installed has improved considerably, much of it was designed in the early 1980s and does not incorporate the technology and tools subsequently developed through Federal research or the experiences of industry in operating turbines. Existing technology must be improved in order for wind energy to be widely cost competitive in domestic and international markets. Identifying these improvements is the objective of the conceptual design studies. Three contracts for conceptual design studies are now being negotiated. These studies will be continued and evaluated through FY 1991, with $400,000 allocated for their completion. Based on the degree of improved performance obtained as a result of those designs, and other factors, the development of one or more advanced turbines will be considered in planning the FY 1992 and future budgets.

Mr. Fazio. Pacific Gas and Electric, the world's largest purchaser of electricity produced by wind energy, predicted in January of this year that with today's low fuel prices, "wind energy will become the most economic new base load source by the year 2020." PG&E went on to indicate that if fuel prices rise substantially, wind could be the most economic new source of electricity within the next two years. Do DOE's findings parallel those of PG&E?

Mr. Davis. PG&E has long been an active participant in renewable energy development and wind energy in particular. A major reason for this is that within the PG&E service territory are excellent wind resources in Altamont

Pass, Solano County, and other sites. The economic attractiveness of wind energy depends on the performance of the technology, the suitability of the wind resource, operating and maintenance costs, the risk of the technology, and the economics of the competition. In the PG&E service territory, especially with the excellent match of wind energy to load and the high average wind speed that PG&E identified in Solano County and with the expected future increase in the utility's avoided costs, wind energy could be quite attractive in view of the savings in fuel and capacity that might be realized. Thus we agree with PG&E that wind energy shows potential, but the major uncertainty is the degree of cost-competitiveness that wind can achieve in the much larger, but more moderate, wind speed regions of the U.S.

FUNDING REQUIREMENT FOR THE
ENVIRONTMENTAL RESTORATION AND WASTE MANAGEMENT FIVE-YEAR PLAN

Mr. Fazio. Mr. Duffy, you spent the first five-and-a-half pages of your testimony outlining the great lengths to which the Department has gone to develop a reasonable and meaningful Environmental Restoration and Waste Mangement Five-Year Plan. You have told us your top priorities and the fact that you have opened yourselves up to comment and review from EPA, the States and others. Then, on page 6 of your testimony, you tell the Committee that you have cut $142 million from the 5-year plan you've just spent the last year developing and consulting with everyone about. You cite the large number of sites and the "probably delays in attracting and acquiring the required technical and administrative staff at DOE and in the States to administer this large, complext program." You make it sound like the Department just discovered this cleanup is going to be big problem. What has changed since you so carefully and thoroughly developed you five-year plan?

Mr. Duffy. Recall that the Five-Year Plan was published in August, 1989 based on information collected 6 months earlier. We do understand more about the cleanup and restoration problems facing the Department including the difficulty in getting the necessary agreements with the States and localities and the need to build an adequate staff at DOE and in the States to do the complext job facing us.

FORECAST OF PROJECT SLIPPAGES

Mr. Fazio. What makes you less confident about your ability to carefully and prudently spend this last $142 million in your 5-year plan than any other portion of the $2.79 billion you have requested in FY 1991?

Mr. Duffy. This budget request attempts to portray a realistic assessment of the funding requirements associated with the Five-Year Plan. We continue to improve our understanding of the severity of our problems and probable schedules for their resolution. If conditions change with funding implications we will appropriately notify Congress.

Mr. Fazio. If Congress found a way to appropriate the $142 million you cut from the 5-year plan, isn't it true that you could efficiently and prudently obligate those monies?

Mr. Duffy. The FY 1991 budget is $563 million over the FY 1990 level and approximately $1.2 billion more then initially requested for FY 1990. We consider the request of $2.791 billion adequate to fund the highest priorities of Five-Year Plan recognizing the potential of slippages occurring in a program in a rapid build-up like this one.

OFF-SITE MIGRATION/PACE OF CLEANUP

Mr. Fazio. Mr. Duffy, I have been told that there continues to be off-site spread of ground water contamination at a number of sites, such as Hanford, Rocky Flats, and Savannah River. Is this correct?

Mr. Duffy. While groundwater contamination exists at most DOE sites, the off-site spread of contamination is being addressed as one of the highest environmental restoration priorities. The potential for off-site spread of groundwater contamination at Hanford is due to the 1100 Area Vehicle Maintenance Facilities, and remediation of this site is being addressed first under the Hanford Tri-Party Agreement. Groundwater contamination at Rocky Flats and Savannah River is also being addressed as a high priority, to prevent contamination from spreading off-site.

Mr. Fazio. Is the cost of cleanup at these sites increasing faster than we are cleaning them up?

Mr. Duffy. A number of innovative technologies are under development to address the cleanup of contamination, especially in the groundwater to keep costs contained. These technologies include in-situ bioremediation of groundwater and treatment of the sources of contamination by various methods to lower the costs of remediation as compared to conventional pump-and-treat or removal techniques.

Mr. Fazio. When do you expect to stabilize these sites?

Mr. Duffy. The Hanford, Rocky Flats, and Savannah River sites are being addressed within the terms of the specific interagency agreements and consent orders negotiated for each site. Interim remedial actions to prevent the

spread of contamination to off-site groundwater have already been initiated at Savannah River and Rocky Flats and will be initiated at the Hanford 1100 Area in FY 1991. Overall cleanup is expected to be completed at these sites within the 30-year goal established by the Department.

Mr. Fazio. If we increased the environmental restoration account above the budget request, would we save money in the long-run by tacking some of these sites that are not stabilized?

Mr. Duffy. Increases to the environmental restoration account above the requested amount would not necessarily save money in the long-run. The initial phases of restoration at most sites are limited by site characterization activities and subsequent regulatory reviews and public involvement steps mandated by law and agreement. Also, the development of new technologies currently underway has significant potential for lower overall costs of cleanup in the future.

FUNDING REQUIREMENT FOR THE
ENVIRONTMENTAL RESTORATION AND WASTE MANAGEMENT FIVE-YEAR PLAN

Mr. Fazio. Mr. Duffy, a year ago before this committee, the Department said that their total cost estimates for cleanup were too high. GAO has since testified that probably the costs will go up. What is your feeling now about the total costs of the cleanup efforts: is your estimate of the total price tag too high, about right, or too low (current estimates are close to $100 billion)?

Mr. Duffy. The cleanup of DOE's installations is in a comparatively early stage of implementation. Although many cleanup actions are underway, the major fraction of current specifications concerning the nature, extent, amount of contamination, required technology, and specific cleanup action are based, generally, on data derived from ongoing site assessments. Consequently, most current cleanup cost estimates should be considered to be projections base on what has been learned from, as yet, incomplete characterization of known sites. Such projections reflect only partial technical data, assumptions concerning significant cleanup needs, and possible methods of accomplishing cleanup tasks. I don't have a basis for confirming or denying the GAO estimates. Instead, we feel that the planning vista for the Five-Year Plan is the correct one and provides the longest range projection which at this time is reasonably credible.

ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT
CLEANUP COST ESTIMATES

Mr. Fazio. What steps is DOE taking to develop more precise estimates of the cleanup costs? When will we have a more accurate estimate of the costs?

Mr. Duffy. DOE develops cost estimates in order to request funding to carry out cleanup activities, but there is considerable uncertainty with regard to such costs at the present time. Costs are strongly dependent on the requirements, extent, and nature of specific cleanup actions. Estimates of cost reflect the degree to which the aggregate of engineering and remedial work connected with specific sites progresses, becoming more detailed and precise as work proceeds. The cleanup of DOE's installations is in a comparatively early stage of implementation. Although many cleanup actions are underway, the major fraction of current specifications concerning the nature, extent, amount of contamination, required technology, and specific cleanup action are based, generally, on data derived from ongoing site assessments. Consequently, most current cleanup cost estimates should be considered to be projections based on what has been learned from, as yet, incomplete characterization of known sites. Such projections reflect only partial technical data, assumptions concerning significant cleanup needs, and possible methods of accomplishing cleanup tasks.

Based on the results of ongoing site assessment and cleanup work, DOE continually updates its estimates of program cost. Such cost updates are to be reflected in each annual revision of the Environmental Restoration and Waste Management Five-Year Plan. As time progresses and assessment efforts are completed at a majority of the DOE sites, a more accurate estimate of the total cleanup costs will be able to be provided.

"TIGER TEAM" EVALUATION AND FOLLOWUP

Mr. Fazio. It would be useful Mr. Brush to take a look back on the progress and effectiveness of the recent efforts to reform the Department and to address the severe environmental and health problems plaguing DOE as this Committee begins to make decisions about future appropriations.

Last summer, Secretary Watkins initiated an internal "Tiger Team" evaluation process for over 30 DOE facilities covering the areas of environment, health and management. It is my understanding that your office, Mr. Brush, is responsible for reviewing the draft Tiger Team action plans, and your prepared testimony indicates that you have completed these action plans at 10 DOE facilities thus far. Have these action plans been implemented at these facilities?

Mr. Brush. "Tiger Team" Compliance Assessments have been completed at 10 DOE facilities, as I indicated in my prepared statement. Eight final action plans have been prepared by the relevant Program Senior Official. These have either been approved by the Secretary or are under review by my Office. Implementation of the activities described in both the draft and final action plans is underway at all 8 sites. Some corrective actions have been completed while others are underway and may require several years to complete.

Mr. Fazio. How many compliance assessments will you perform in the remainder of FY 1990? How many in FY 1991?

Mr. Brush. We plan to conduct 13 "Tiger Team" Compliance Assessments in FY 1990 and 12 in FY 1991.

Mr. Fazio. Are adequate funds included in the budget to implement the action plans, and, if not, what is the shortfall?

Mr. Brush. The Department's policy is to bring its facilities into full compliance with environmental, safety and health requirements. Tiger Team action plans contain costs and to the extent possible the identification of funds for corrective action. With the continued support of this Committee and the entire Congress, the Department will have the funds necessary to achieve full compliance.

Mr. Fazio. Is the concern about the adequacy of resources for implementing the action plans leading you to slow the pace of these Tiger Team assessments?

Mr. Brush. Absolutely not. The Department is proceeding with the "Tiger Team" Compliance Assessments on an aggressive, fast-paced schedule.

Mr. Fazio. Without adequate resources for followup efforts, the Tiger Team findings may not result in any improvement at the facilities and in the Department. One of the first Tiger Team evaluations was conducted at Fernald. The action plan was due on October 20, 1989, and as I understand

it, the action plan has not been completed. Does your proposed budget for FY 1991 for the cleanup at Fernald reflect the findings of the Tiger Team evaluation or is that cleanup proceeding without the benefit of the findings of the Tiger Team evaluation?

Mr. Brush. The timing of the FY 1991 budget process did not permit the findings from the Fernald "Tiger Team" Compliance Assessment to be specifically factored into the FY 1991 budget. The findings and the action plan for the Fernald "Tiger Team" Compliance Assessment will be fully factored into the FY 1991 budget implementation plans.

ENVIRONMENT, SAFETY AND HEALTH

Mr. Chapman. Mr. Brush, what staffing changes do you anticipate will occur in the Office of Environment, Safety and Health once the Secretary's Ten Point Plan and other management reforms are fully implemented?

Mr. Brush. The Secretary's management reforms, Ten Point Plan and several other initiatives, coupled with the establishment of the Defense Nuclear Facilities Safety Board and the continued support of the Advisory Committee on Nuclear Facility Safety, have resulted in some changes in the responsibilities of the Office of Environment, Safety and Health. This office will no longer be responsible for nuclear facility safety policy or oversight. The Office of Environment, Safety and Health will continue to perform oversight in the areas of environmental protection, radiation safety, worker safety, non-nuclear facility safety, emergency preparedness, and those aspects of public health and safety that deal with epidemiology and radiological protection at DOE facilities. This applies both to defense and non-defense facilities. In addition, the Office of Environment, Safety and Health is responsible for carrying out a number of new initiatives such as the "Tiger Team" Compliance Assessments, establishing an OSHA-type safety program and implementing the new NEPA policy.

These changes in responsibilities will have some impact on the skill mix for this office. For example, we will need to obtain more staff with experience in OSHA-type safety and radiation protection to carry out the initiatives we have undertaken in these areas.

Mr. Chapman. Is the concept of independent Tiger Teams new? What successful precedents for this type of oversight program can you cite?

Mr. Brush. The concept of conducting environment, safety and health appraisals and audits is not new. The components of the "Tiger Team" Compliance Assessments are being conducted in accordance with established protocols and procedures. The Department's "Tiger Team" effort is unprecedented in a number of important ways. The "Tiger Team" Compliance Assessments are comprehensive, integrated assessments of environment, safety and health compliance status and management programs at each site. These assessments also identify root causes for non-compliances and are conducted in a new spirit of openness.

Mr. Chapman. On page 206-207 of the FY 91 DOE Congressional Budget Requests, Vol. 2, ("Analysis of Environmental Regulations") the Department requests $1.35 million to "[e]nhance the analysis of Resource Conservation and Recovery Act rulemakings specific to offshore and arctic oil and gas exploration and production. Conduct specific options analyses associated with energy efficiency." Could you please explain the program in more detail?

Mr. Brush. This subprogram estimates the impacts on the U.S. energy industry due to proposals of new, or modifications to existing, environmental regulations. Impact areas include energy supply constraints and price effects, capital and operating cost-of-compliance, employment changes, and cost-effectiveness of alternatives. Such information allows

full and balanced consideration of effects during the regulatory development process. Regulatory activity occurs, to varying degrees, across all the major environmental acts each year.

For the current fiscal year, examples of regulatory issues analyzed include: emissions guidelines and performance standards for municipal waste combustors and mobile source NOx control options under the Clean Air Act (CAA); oil and gas underground injection well regulatory programs under the Safe Drinking Water Act (SDWA); toxicity test procedure for hazardous determination for oil and gas wastes under the Resource Conservation and Recovery Act (RCRA); redefinition of the coastal oil gas extraction sub-category under the Clean Water Act (CWA); and energy industry impacts of changes to the Hazard Ranking System under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA).

With the anticipated reauthorization of the CAA this year, regulatory analysis emphasis will be on codification activities of the new Act in 1991. We anticipate, for example, needs for analysis of potential regulation for air toxics and volatile organic compounds from transportation-related emissions. The energy related background studies to support DOE participation will center on electric utilities, oil and gas extraction, production and distribution systems and industrial combustion sources.

Other anticipated analysis will include assessment of construction requirements for Class II oil and gas wells under SDWA; oil and gas "associated wastes" and waste minimization issues under RCRA; effluent guidelines for the oil and gas offshore subcategory (CWA).

SOLAR AND RENEWABLES

Mr. Pursell. What role do you see for solar and renewable energy as part of the President's National Energy Strategy?

Mr. Davis. The National Energy Strategy (NES) is designed to provide direction for the Department's future policy and funding initiatives. The strategy will rely heavily on public input through hearings, written submissions, and other published available reports, all aimed at reconciling our need for secure, competitively priced supplies of energy that meet environmental, safety, and health requirements. An interim report based on the findings from the public hearings will be presented to the President in April 1990. Following this report, the Department will conduct additional hearings to help identify appropriate options to recommend to the President in our final report in December. Although the NES is not yet complete, public input suggests a broad interest in increasing emphasis on renewable energy programs. I expect this emphasis to continue throughout the NES development.

Mr. Pursell. What percent of our nation's energy needs are being met by solar and renewables today? How does this compare to 10 years ago, and how does it compare to what you would like to see 10 years from now?

Mr. Davis. Currently renewable energy contributes over 9% of the nation's domestic energy supply, as compared to an 8% contribution in 1980. The latest Energy Information Administration forecast projects a 11% contribution to domestic energy production from renewables in the year 2000. We are committed to the development of renewable energy and expect its contribution to increase

over the next two decades, as technologies now under development become deployed in the marketplace.

Mr. Pursell. Solar and renewable energy sources require a long-term research program. Do you agree that we must emphasize this research today, if we are to have any hope of making this a larger percentage of our energy source in the future?

Mr. Davis. There is a range of renewable energy technologies that could enter the marketplace across the short, mid, and long term. To capitalize on the immense resource potential represented by these renewable technologies will require joint research and development by the Federal and private sectors. The FY 1991 renewable energy budget request indicates the Department's commitment: an increase of 55 percent over our request last year and 27 percent over our FY 1990 appropriation. It represents a balanced program to make renewable options available in the short, mid, and long term. It commits to joint development of these technologies with private industry to assure direct technology implementation in the market.

GLOBAL WARMING

Mr. Pursell. Has the threat of global warming resulted in an increased interest in renewable energy?

Mr. Davis. The global warming issue has undoubtedly caused some individuals and organizations to focus on energy conversion and utilization technologies, the two principal energy sources of greenhouse gas emissions.

Since renewable energy supplies are acknowledged as relatively benign with respect to global climate change, it is likely that interest in their potential has increased.

RENEWABLE ENERGY

Mr. Pursell. Have recent record oil imports resulted in an increased interest in renewable energy?

Mr. Davis. The high level of oil imports is a concern for a number of reasons, including its detrimental effect on national security and the Nation's balance of payments, and has heightened awareness of the attractiveness of potential domestic substitutes for imported oil. The Department has proposed a major initiative in the FY 1991 budget request to develop technology for the production of alcohol fuels (both ethanol and methanol) from biomass. Use of biomass-based alcohol fuels would offer advantages beyond the reduced need to import transportation fuels. By absorbing carbon during the biomass production phase nearly equal to that released during the energy phase, biofuels can reduce their net emissions of greenhouse gases to nearly zero. Biomass fuels could be produced on currently underutilized croplands, increasing national agricultural productivity. Finally, they are renewable and thus contributing to our transportation needs well into the future.

WIND ENERGY RESEARCH

Mr. Purcell. Could you provide us with an update on Wind Energy Research? How does the U.S. compare to other nations in this regard?

Mr. Davis. Wind energy provided one percent of California's electricity in 1989 with more than two billion kilowatt hours produced last year. Mechanical availability of new turbines is substantially improved over those of several years ago, and energy capture has improved measurably. Wind resources in California are quite good.

However, reductions in cost as well as improvements in performance are needed for wind energy to be cost-effective in other regions. Developing improved methods for siting and designing wind turbines as well as improved components, such as airfoils, is a major objective of the DOE Wind Energy research program. These and other efforts are conducted by staff at three laboratories and a number of industrial and university contractors. This level is roughly comparable to the research effort in other countries with wind energy programs. However, several large turbine development programs are under way in other countries.

Mr. Purcell. In FY 1990, Congress funded Wind Energy R & D at $9.35 million, including funds for the Advanced Wind Turbine Initiative (AWTI). The AWTI would reduce kilowatt costs, reduce capital costs, and increase installed capacity. The President is proposing a significant increase for Solar Energy, but a decrease to $8.6 million for the AWTI. Do you believe this is a significant level of funding to move forward with the program?

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RENEWABLE ENERGY BUDGET

Mr. Davis. In preparing the President's FY 1991 budget request, the Department conducted a thorough review of the Renewable Energy Program, including the Solar programs. We looked at near-term potentials, what could be done to accelerate near-, mid- and long-term contributions, and where our highest priorities ought to be. In order to realize the full potential of wind energy, we are in the process of negotiating three contracts for conceptual designs of advanced turbines. The program represented by the FY 1991 budget request will provide for the completion of the effort. Information gained from that effort, coupled with other reviews, will be used to develop new long-range plans for FY 1992 and future years. Consequently, I believe that the requested level is adequate to continue moving forward in 1991.

PERCENT OF DOE BUDGET DEVOTED TO CLEANUP

Mr. Pursell. DOE's environment and safety record is absymal. What percentage of the FY 1991 budget is earmarked for these programs, and how does this compare to recent years?

Mr. Duffy. The FY 1991 budget request for Environmental Restoration and Waste Management (EM) is $2.791 billion, an increase of $573 million and 26 percent over the FY 1990 level. It is approximately $1.2 billion over the initial budget requested for FY 1990. In terms of the overall DOE budget, the EM request represents 15.7 percent of the total in FY 1990 and 17.5 percent in FY 1991. This budget continues the rapid acceleration of cleanup of DOE facilities started by President Bush's allocation of $300 million to the FY 1990 budget request and the Congress's action to appropriate an additional $357 million by FY 1990.

PROJECTION OF FUNDING NEEDS FOR CLEANUP

Mr. Pursell. What more will be needed in the future--how much more money and how many more years?

Mr. Duffy. The Five-Year Plan identifies approximately $19 billion for FY 1990--1995 for completing the highest priorities of the Plan. The Five-Year Plan is now being updated and will contain a revised forecast of funding requirements. Most cleanup cost estimates should be considered to be projections based on what has been learned from, as yet, incomplete characterization of known sites. The Plan's horizon is five years which is the longest range projection which, at this time, can be considered reasonable and credible.

DOE continues its commitment to environmental stewardship and its goal of cleanup at all sites within 30 years.

USING REMOTE SENSING FOR ENVIRONMENT AND SAFETY ACTIVITIES

Mr. Pursell. Do you foresee a role for remote sensing, from either aircraft or satellites, in the Department's Environmental Restoration and Waste Management work?

Mr. Duffy. The Department has successfully used remote sensing from aircraft for many years (at least 25) to monitor radiation levels at its principal facilities. We anticipate continuing this effort in the future. We are currently evaluating several proposals to use satellites for remote sensing. Satellite imaging to monitor long-term environmental trends has been proven, and we are trying to determine if this technique can be applied on the scale of a DOE facility. We are working with the National Aeronautics and Space Administration in this field and expect to sign a memorandum of agreement for cooperative research and development later this year.

WIND ENERGY

Mr. Watkins. Oklahoma is one of the largest producers of energy in the U.S. as a result of wind energy turbines. Because of this and the available wind power in the State, I am interested in what research is being done by DOE in wind energy. In 1989 the U.S. invested less than $9 million for federal wind energy R&D programs. According to DOE, in that same year, the EC spent about $13 million; Germany, nearly $17 million and the Netherlands nearly $24 million.

Could you describe for us how the U.S. compares to the countries of Sweden, the United Kingdom, Germany, Italy, and the Netherlands -- in the export of wind energy technology to developing countries? And also could you describe related activities to industrial countries?

Mr. Davis. The countries that you named have active wind research and machine development programs. Their objectives vary, but all appear to see a domestic market for wind energy, while several such as the Netherlands and Denmark are also quite active in promoting their technology in developing countries. Until recently, the United States has been the primary market for wind turbines in the industrial world. Significant numbers of turbines from Denmark, the Netherlands, Belgium, the United Kingdom and Japan have been installed in the U.S. Europe may become a significant market in the 1990s as trade barriers are eliminated, and DOE is trying to assure that our manufacturers have a level playing field by supporting participation by representatives of our industry in European and international standards development for wind turbines.

Mr. Watkins. Do you find a correlation between other nations' R&D in wind energy technology and their exports of wind energy equipment?

Mr. Davis. Not always. The level of R&D appears to relate to the need for alternative electric power resources in the country, the availability of domestic wind resources and the degree to which they stress export markets. Some of the funding amounts you cite may also contain non R&D activities which further blurs the issue.

Mr. Watkins. DOE requested $8.6 million for wind energy R&D for FY 1991 and OMB allowed the requested amount. In requesting $8.6 million for wind energy R&D projects for FY 1991, the Administration has sought less than was appropriated for FY 1990 and substantially less than was recommended by three Congressional authorizing committees last year.

What considerations went into making the budget recommendations to OMB for the wind energy R&D programs?

Mr. Davis. The principal determinant was a top to bottom re-assessment of the overall Renewable Energy program. Priorities were set to accelerate those programs and program elements that offered greatest payoff to the Nation. The request for some programs was increased, and for others was reduced; wind energy fell in the middle group that is roughly level. We will continue looking at priorities for wind and all other programs carefully during formulation of the FY 1992 request.

HIGH TEMPERATURE SUPERCONDUCTIVITY

Mr. Chapman. The Department requests an 82% increase in the budget for Systems and Materials Research, which includes the High Temperature Superconductivity program and the related Pilot Centers. Could you please describe in more detail what this expanded program will buy?

Mr. Davis. Increases in the budget for Systems and Materials research will support expanding the DOE Superconducting Pilot Centers from FY 1990 funding of about $6 million to $15 million in FY 1991. Currently the Pilot Centers are resource limited. There are many more companies expressing interest in forming collaborative agreements with the Pilot Centers than can be accommodated with current funds. Present agreements cover a wide variety of industry-proposed topics, including high critical current density conductor development, thin film characterization and deposition, materials structural studies, thallium materials processing, cladding of conductors, materials for large and small superconducting magnetic energy storage, metal matrix composite conductors, a small electric motor, magnetic bearings, and microgravity material processing. Increasing the level of support for Pilot Center activities will allow further involvement of the industrial sector in developing HTS material technologies and applications.

Mr. Chapman. Is the increased focus of the High Temperature Superconductivity program on industrial cost-shared initiatives making it more difficult for individual researchers in this country to obtain federal funding for superconductivity research?

Mr. Davis. With respect to Conservation and Renewable Energy funding, growth in the Pilot Center interactions with industry has been supported by additional funding appropriations; the core program for high-temperature superconducting technology for electric power applications has remained more or less level. Additional expenditures in the core research program could provide benefits by increasing contributions from individual researchers, but it is believed that funding nearer-term applications with collaborative efforts with industry will accelerate development of a high-temperature superconductivity industry in the United States. In the current environment of tight budgets, we view the development of a U.S. capability through Pilot Center/industry collaborations to be the higher priority.

SOLAR DETOXIFICATION

Mr. Chapman. The request for funding for solar detoxification of hazardous waste is $8.6 million, more than double last year's funding level. Can you describe in more detail what this expanded program would entail.

Mr. Davis. This technology has shown great promise for hazardous waste mitigation. Two toxic waste problems can be mitigated with solar-assisted detoxification technology. One is water contaminated with toxic chemicals such as solvents, and the second problem is concentrated wastes such as PCB and dioxin, which would otherwise have to be stored or incinerated. Emphasis will be placed on water reclamation in FY 1991 because the solar-assisted technology is closer to development for this toxic waste problem.

Water contaminated with toxic chemicals is treated with sunlight-activated catalysts in the presence of moderate (thirty to fifty sun) solar concentration. Available catalysts use only a fraction of the solar spectrum in the process. Research will be expanded on catalysts to make use of a larger portion of the solar spectrum.

A field test of detoxification of water contaminated with toxic chemicals at a DOE hazardous waste site is also planned; this will be the first test of the technology at a waste site. Test results will provide valuable information on the effectiveness, costs, and viability of the technology.

GEOPRESSURED RESEARCH

Mr. Chapman. Please explain the 50% decrease over the FY 1990 appropriation in the Department's FY 1991 request for Geopressured Research.

Mr. Davis. During the past 15 years that the Geopressured-Geothermal Program has been active, primary emphasis was placed on acquiring data from geopressured reservoirs. This activity, which involves the drilling or refurbishment and testing of relatively deep wells, is expensive. Since 1976 over $184 million has been committed to the program. The Department intends to complete testing activities at the three remaining well sites sequentially, beginning with Gladys McCall. Thereafter, priority will be given to analysis and synthesis of the considerable data base that has already been accumulated.

The objective is to provide industry with the types of information it will need to make reliable investment decisions about utilizing the resource. These activities are less costly that the testing of deep wells in the field.

Mr. Chapman. What preliminary flow test results are available from the Pleasant Bayou well in Texas? What results have been obtained from the hybrid electric power system at the Pleasant Bayou site?

Mr. Davis. Flow test data from the Pleasant Bayou well has provided the temperature, pressure, and chemical composition of the brine. We also have analyzed the organic chemicals in the brine and the produced natural gas, and have used the flow measurements to model the reservoir and determine its size. Several months' operation of the hybrid power system have shown that it is possible to extract more electric power from the gas stream and brine stream together than can be obtained from the two independently.

GEOTHERMAL ENERGY

Mr. Chapman. The request for Geothermal Energy is roughly level with the FY 1990 funding. What are the Department's goals for this program in the immediate future? In the long-term?

Mr. Davis. The Department's goals in the immediate future are to work closely with the geothermal industry in solving the critical technical problems which retard the economic exploitation of the Nation's low- and moderate-temperature hydrothermal resources. In the long-term, the Department

will address the much larger but more difficult to develop geothermal resources: geopressured, hot dry rock, and magma.

HYDROPOWER

Mr. Chapman. Mr. Davis, you state (on page 4) in your testimony that the Department is proposing "a $1 million effort to characterize the hydropower resource, regulatory process, and technical requirements and $2.5 million to fully characterize the energy and environmental outputs of municipal waste combustion, disposal, and recycling. Can you describe the timetable anticipated for such an investigation? What are your long-term goals for hydropower?

Mr. Davis. Three major factors which are currently restricting hydropower's contribution to the national energy mix have been identified during the National Energy Strategy process. These are: the lack of a single focus for final decisions regarding hydropower regulation and development; a time-consuming, disorganized, and costly licensing/permitting process due largely to the duplicative environmental review process with overlapping layers of jurisdiction; and a need for specific R&D with regard to environmental assessment methods.

While a number of regulatory issues and potential reforms have been identified, the Department must now critically analyze, review, and prioritize these issues and options for reform to determine those areas where effort can be most beneficially spent. The Department will then conduct appropriate studies and coordinating activities with other regulatory and resource

agencies to attain the long-term goal of resolving impediments and facilitating industry development of hydropower resources. While we are not yet in a position to set a detailed timetable, a multi-year effort may be needed due to the complexity of the regulatory process and the many organizations involved. Similarly, while we are not yet in a position to set a timetable for the municipal waste initiative, we believe that it will be a multiyear effort. About two years will be required to collect and analyze the data on existing facilities and fully define the data gaps. We will begin to fill those data gaps in the second year of the effort. Meanwhile we will be developing solutions to some of the known inhibitors of municipal waste technologies such as ash disposal from combustors and short fiber management from paper recycling.

WIND ENERGY

Mr. Chapman. The Department's Fiscal Year 1991 request for the Wind Energy Program is 6 percent less than the FY 1990 appropriation, including a 29 percent decrease in Advanced Components Research. Please explain this decrease. Do you anticipate a smaller role for the Department in the area of Wind Energy in the future?

Mr. Davis. The overall level of the request for the Wind Energy program was carefully considered in the context of the Department's priorities for the Renewable Energy Program. Our FY 1991 strategy was to focus new resources on key, high potential activities, while keeping others such as wind approximately level. The apparent decrease in the request for FY 1991 is due to the funds added for the Advanced Wind Turbine Program in the FY 1990

appropriation. We are fully funding the contractors' portions of the conceptual design studies in FY 1990 as the initial phase of this program. Thus additional funding is not required in FY 1991; there is sufficient funding to complete these studies and to evaluate them. We do not foresee a declining role for the Wind Energy Program, and I will be re-evaluating all our programs in formulating the FY 1992 request. Our strategy and future funding proposals for wind energy will be based, in part, on the expected increases in performance that could be achieved with advanced technology based on the conceptual design studies and other technological advances.

HYDROGEN RESEARCH

Mr. Chapman. This subcommittee has recognized hydrogen energy's importance in the renewable energy area. We notice a request for $2.5 million for hydrogen from renewables. Does the Department feel this is a sufficient amount to support ongoing research in this field?

Mr. Davis. We believe that the Department's recommendation for renewable hydrogen is appropriate. The renewable energy request is only a portion of the total DOE hydrogen budget. Other hydrogen energy research is being funded within the Energy Research and Fossil program budgets. In addition, work sponsored by the Defense and Nuclear Energy programs has direct application to the resolution of many problems that must be solved before hydrogen can become a major energy source. These activities are coordinated through a Hydrogen Energy Coordinating Committee which is composed of program managers in the Department and which stays current on the research and hydrogen needs of other Federal agencies such as NASA and Defense.

Mr. Chapman. Has the Department's view of hydrogen from renewable energy changed from previous years?

Mr. Davis. The FY 1991 budget request for Renewable Hydrogen research reflects certain differences from previous years. First, we have moved hydrogen from the Energy Storage and Distribution budget account to the Biofuels Energy System account. This action has served to better focus and define the role of hydrogen as an energy option in both the mid and long term. We are currently reviewing a long-range program plan for hydrogen. When the internal review is complete, we will have the plan reviewed by the private sector to acquire further input prior to its finalization as a guiding document. To my knowledge this will be the first time that the Renewable Energy hydrogen program has had a peer-reviewed guiding document that provides a coordinated research and development strategy and an end goal. With respect to the role of hydrogen, our view remains essentially unchanged. From an environmental standpoint, hydrogen is an attractive energy carrier that can be utilized in a variety of aplications. From an energy standpoint, the production of hydrogen from water unavoidably requires more input energy than is returned by the hydrogen output. Consequently, hydrogen production must be addressed in concert with the energy source used for the production. Various renewable hydrogen combinations assuming certain technical advances, appear to be reasonable candidates at this time.

ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT

Mr. Chapman. The Department's budget provides $19 billion for FY 1990-95 for the "highest priority activities of the Five-Year Plan." Mr. Duffy, what is your best estimate of the total long-term cost of the cleanup of the DOE facilities?

Mr. Duffy. In the Environmental Restoration and Waste Management Five-Year Plan, issued in August 1989, the Department committed to the goal of cleanup of its facilities and sites within 30 years. The Department recognizes that attainment of this goal will require successful development and implementation of new technologies. Nevertheless, the Department remains committed to this goal. An overall analysis to determine a total cost of cleaning up its entire nuclear complex has not been performed. The Department does not believe it is appropriate or possible, at this time, to predict the total cost of cleanup. Any estimate of a hypothetical total cost would likely be misleading and invalid. DOE develops cost estimates in order to request adequate funds each fiscal year for carrying out cleanup activities, but uncertainty exist with regard to such cleanup cost estimates. Costs are strongly dependent on the requirements, extent, and nature of individual cleanup actions, and estimates of cost reflect the degree to which the aggregate of engineering and remedial work connected with specific sites progresses, becoming more detailed and precise as work proceeds. The cleanup of DOE's installations is in a comparatively early stage of implementation. Although many cleanup actions are underway, the major fraction of current specifications concerning the nature, extent, amount of contamination, required technology, and specific cleanup action are based, generally, on data derived from ongoing site assessments. Consequently, most current cleanup

cost estimates should be considered to be projections based on what has been learned from, as yet, incomplete characterization of known sites. Such projections reflect only partial technical data, assumptions concerning significant cleanup needs, and possible methods of accomplishing cleanup tasks.

Based on the results of ongoing site assessment and cleanup work, DOE continually updates its estimates of program cost. Such cost updates are to be reflected in each annual revision of the Environmental Restoration and Waste Management Five-Year Plan. As cleanup efforts proceed, we will be able to make a more definitive estimate of the total cost of cleanup.

COMPREHENSIVE REVIEW OF TECHNOLOGY DEVELOPMENT

Mr. Chapman. On page 8 or your statement, you note that the Department is conducting a comprehensive internal and external review of technology development needs and priorities. When do you anticipate the completion of this review?

Mr. Duffy. The target FY 1990 funding allocations for technology development have been set and all remaining funding will be released to field elements for new research and development initiations in the April-May timeframe. Research and development needs in these areas are identified and innovative problem-oriented approaches are constantly emerging. Internal and external peer review is necessarily an ongoing process required in order to assure new, more effective and less costly technologies will be deployable in time to meet regulatory requirements. We believe that internal and external review is a necessary component for success and expect it to continue as an integral part of our program.

CONTINUITY OF OPERATIONS

Mr. Chapman. The request for Continuity of Operations to comply with RCRA-based regulations is $283 million. Do you anticipate a near-term future decline in Continuity of Operations requests, as reorganization and improved oversight takes effect?

Mr. Duffy. The Department anticipates a near-term increase in Continuity of Operations to have DOE sites comply with RCRA-based regulations. DOE is directing its facilities to assess and identify out-of-compliance areas. Since new compliance issues may be identified by DOE's line management and oversight organizations, increased funding will likely by required. This is expected to taper off later as compliance is reached.

WASTE ISOLATION PILOT PLANT

Mr. Chapman. The Waste Isolation Pilot Plant operational date has slipped, as you noted. Do you anticipate a resolution of the preoperational activities described in your testimony (pp. 13-16) within the calendar year?

Mr. Duffy. The Department is tracking the critical issues associated with WIPP in a Decision Plan which is updated monthly and issued by the Secretary to Congress, the affected States, other Federal agencies and oversight/interest groups. In June, 1990, the Secretary will evaluate the status of all remaining prerequisites and could announce the projected date for the initiation of the Test Phase using actual waste. A major prerequesite, the needed submission of land withdrawal legislation, is now before OMB for review.

Mr. Akaka. What advantages does Hawaii have as a site for achieving maximum utilization of biomass energy development?

Mr. Davis. Hawaii has a number of advantages as a laboratory for the development of biomass energy systems. Some of those, such as the long growing season, the high rainfall on the east side of the islands, and the devotion of significant land resources to agriculture, are well known. Others are less well known, such as the recent use of bagasse, an agricultural waste from the sugar industry, to supply as much as 30 percent of the electric needs of the big island and the construction of a municipal waste-to-energy plant on Oahu. The import of all vehicle fuels to the islands and the isolated nature of each island provide potentially significant incentive and opportunity.

Mr. Akaka. How is the biofuels program at the Hawaii Natural Energy Institute helping Hawaii achieve its potential for biomass energy development.

Mr. Davis. The Department's research contract with the Hawaii Natural Energy Institute has helped Hawaii to develop a better understanding of the available resource base, to increase the productivity of short rotation eucalyptus trees, and to test the use of that wood in an existing electric generation plant. Alcohol fuels research support has principally focused on the conversion of biomass to methanol. In addition, the Department has furnished information and is assisting in the experimentation on energy cane which is a particularly fast growing species of sugar cane that can quadruple the energy output per acre.

Mr. Akaka. The FY 1988 appropriations for Biofuels Energy Systems included $500,000, "To continue the Hawaii Biofuels Program at the Hawaii Natural Energy Institute (HNEI)." With respect to this $500,000 appropriation, identify: (1) amounts (list specific dollar amount) received by HNEI, (2) amounts received by entities other than HNEI; and (3) amounts yet to be disbursed to HNEI or other entities other than HNEI from this appropriation. In identifying each dollar amount, list the date of each disbursement and the specific research activities to be performed.

Mr. Davis. I would be pleased to provide a table as an insert for the record. (Insert follows)

TABLE
Status of HNEI Research and Funding in FY 1988

HNEI

Research Activities

- o Biomass production activities including fast growing nitrogen fixing species, energy grasses, plantation studies, and post harvest technologies
- o Biomass conversion research including:
  - System modeling for methanol production
  - Partial oxidation of wet biomass
  - Solvolysis of biomass
  - Feedstock effects on conversion
  - Infrastructure and market analysis

Funds Distribution

Date	Remarks	Contract Amount	Invoiced	Paid
FY-1988		$365,000.00		
11/10/89			45,113.67	45,113.67
11/10/89			63,451.99	63,451.99
1/10/90			32,997.91	32,997.91
2/12/90			2,090.45	2,090.45
3/6/90			81,153.86	81,153.86
Total			$224,807.88	$224,807.88
Not invoiced		140,192.12		

SERI

Activities

- o Post doctoral research fellow selected by HNEI and hired by SERI conducted research on the molecular beam mass spectrometer
- o Contracting overhead to issue and administer contract
- o Management

Funds Distribution

Date	Remarks	Contract Amount	Invoiced	Paid
FY 1988		$85,000	85,000	85,000

HEADQUARTERS

Activities

- o General reduction
- o Small Business Innovation Research
- o Technical evaluation and assessment activities.

Funds Distribution

Date	Remarks	Contract Amount	Invoiced	Paid
FY 1988		$50,000	50,000	50,000

Mr. Akaka. The FY 1989 appropriations for Biofuels Energy Systems included $500,000, "To continue the Hawaii Biofuels Program at the Hawaii Natural Energy Institute (HNEI)." With respect to this $500,000 appropriation, identify: (1) amounts (list specific dollar amount) received by HNEI, (2) amounts received by entities other than HNEI; and (3) amounts yet to be disbursed to HNEI or other entities other than HNEI from this appropriation. In identifying each dollar amount, list the date of each disbursement and the specific research activities to be performed.

Mr. Davis. I would be pleased to provide a table as an insert for the record. (Insert follows)

TABLE
Status of HNEI Research and Funding in FY 1989

HNEI

Research Activities

- o Biomass production activities including fast growing nitrogen fixing species, energy grasses, plantation studies, and post harvest technologies
- o Biomass conversion research including:
  - System modeling for methanol production
  - Partial oxidation of wet biomass
  - Solvolysis of biomass
  - Feedstock effects on conversion
  - Infrastructure and market analysis

Funds Distribution

Date	Remarks	Contract Amount	Invoiced	Paid
FY 1989		$375,000	-0-	-0-

SERI

Activities

- o Contracting overhead to issue and administer contract
- o Management

Funds Distribution

Date	Remarks	Contract Amount	Invoiced	Paid
FY 1989		$75,000	75,000	75,000

HEADQUARTERS

Activities

- o General reduction
- o Small Business Innovation Research
- o Technical evaluation and assessment activities.

Funds Distribution

Date	Remarks	Contract Amount	Invoiced	Paid
FY 1989		$50,000	50,000	50,000

Mr. Akaka. What advantages does Hawaii have as a site for maximizing the potential for ocean thermal energy conversion?

Mr. Davis. The ocean surrounding Hawaii has an average annual temperature difference suitable for ocean thermal energy conversion (OTEC) extraction and the nearshore topography allows for access to a deep cold water source with a comparatively short length of pipe. Hawaii also has the experience base necessary for implementation of the concept because of the extensive OTEC research conducted at the University of Hawaii and the Natural Energy Laboratory of Hawaii.

Mr. Akaka. How has the DOE research program for OTEC helped Hawaii to move closer to the point where it can exploit its OTEC potential?

Mr. Davis. The DOE Ocean Energy research program for OTEC has experimentally confirmed conceptual feasibility of both the open- and closed-cycle systems. It has provided test data on the adequacy of inexpensive materials of construction; has developed procedures to control biofouling; has developed novel components such as the spout evaporator and low pressure turbine preliminary design for improved energy conversion; has shown the feasibility of producing desalinated water; has researched materials for cold water pipe construction; has developed and demonstrated procedures for the deployment of cold water pipes of varying diameters down steep slopes and to significant depths; and has provided the experimental basis for concept

implementation by industry. All of these accomplishments directly support Hawaiian exploitation of this resource, and several have resulted from the joint efforts of the State, through PICHTR, and the Federal program.

Mr. Akaka. When was the Seacoast Test Facility formally constituted as a DOE research facility?

Mr. Davis. The Seacoast Test Facility describes a collection of OTEC test fixtures which occupy space on the property of the State-owned Natural Energy Laboratory of Hawaii (NELH). The program funds NELH for the services required for operation of the test equipment belonging to DOE. We do not consider the Seacoast Facility a DOE research facility.

Mr. Akaka. Provide copies for the record of any documents which identify the manner by which the Seacoast Test Facility was formally constituted by the Department as a research facility, together with a statement of its mission.

Mr. Davis. To the best of my knowledge, it has not been DOE's intention to constitute the Seacoast Test Facility as a Departmental research facility. Therefore, no documents exist to establish it as such.

Mr. Akaka. What is the status of current research on components and systems capable of being assembled into a net power producing OTEC plant of approximately 165 kW?

Mr. Davis. Components that could be assembled into an OTEC net power producing experiment have been developed through the conceptual design stage

and have been tested at small scale in seawater on the Heat and Mass Transfer Scoping Test Apparatus (HMTSTA) fixture, part of the Seacoast Test Facility located at the Natural Energy Laboratory of Hawaii.

Mr. Akaka. What research remains to be performed on components and systems capable of being assembled into a net power producing plant?

Mr. Davis. Remaining research requirements on components for the 165 kWe OTEC net power producing experiment are limited mainly to the low pressure turbine. The heat and mass transfer experiments provided necessary data on sizing of the largest part of the system. System integration is the next step and will be provided in the preliminary and final design activities now being conducted at the Solar Energy Research Institute (SERI), Argonne National Laboratory (ANL) and Pacific International Center for High Technology Research (PICHTR).

Mr. Akaka. Mr. Davis, the FY 1990 appropriation for Ocean Energy Systems provided $4,178,000 "to continue the PICHTR-OTEC project. Not less than $2,100,000 of the PICHTR-OTEC funds shall be made available directly to the organization established by the State of Hawaii pursuant to Section 3 of Act 152 of the 1983 Hawaii Legislative Session." Based upon this appropriations language, identify amounts that will be disbursed to PICHTR, listing the specific research activities to be performed.

Mr. Davis. The language cited is from the Committee Report rather than the Appropriations Act itself. We are currently processing funding actions which includes $1,897,000 for PICHTR; this represents the $2,100,000

appropriated less proportional reductions for Gramm-Rudman, the general reduction, Small Business Innovative Research, similar requirements and reserves. In the event the reserves are not required, they would be allocated proportionately back to PICHTR and our two laboratories. PICHTR has responsibility for the turbine and final design of the 165 kWe OTEC experiment, and for operation of the test fixtures located at NELH referred to as the Seacoast Test Facility.

Mr. Akaka. Identify amounts that will be disbursed to entities other than PICHTR from this FY 1990 appropriation, also listing the specific research activities to be performed.

Mr. Davis. We are also processing $1,103,000 for SERI, not including the funds for PICHTR which are contracted through SERI. $200,000 is planned for Argonne National Laboratory. All Laboratory funds are to be spent on component and system development for the planned 165 kWe OTEC experiment to be performed at NELH. SERI and ANL are responsible for completion of the preliminary design of the experiment. The remaining DOE headquarters funds are for planning, computer services, SBIR, etc, and reserves.

HYDROGEN

Mr. Akaka. What is your department's evaluation of the prospects for the more widespread development of hydrogen as a transportation fuel.

Mr. Davis. The Nation's entire energy system is now in review as part of the process of developing a National Energy Strategy. It is premature to

judge any one technology until the NES process is completed and all the testimony and input has been weighed. The near-term development of a renewable, or for that matter, any hydrogen system for direct use as a transportation fuel is unlikely. Further photovoltaics development is one of the renewable energy program areas that is being emphasized in this budget. A more reasonable projection by the turn of the century is hydrogen production in the range of $2.00 for the equivalent of a gallon of gasoline. At that price, based upon oil price projections and other technologies in development, hydrogen will not be an economic fuel for conventional engines for some time. For it to compete economically with other gaseous and liquid fuels in the mid-term, an advanced fuel cell propulsion system would almost assuredly be required, and such a fuel cell is under development within the Conservation and Renewable Energy program.

Mr. Akaka. What funds are proposed in the FY 1991 budget for hydrogen research and development? Identify the account through which the research is to be funded and describe the activities to be performed.

Mr. Davis. In FY 1991, $2,500,000 is being proposed for hydrogen research and development in the Biofuels Energy Systems account. These funds will be used to perform research on advanced electrolysis systems that can be teamed with the solar electric systems under development elsewhere in the Department. Other research will continue to develop information on direct solar hydrogen production technologies such as multilayer films and microalgae that split water. Hydrogen storage research will concentrate on activated carbon and metal hydride storage of hydrogen onboard vehicles.

Mr. Akaka. Identify and describe the hydrogen research being performed under the $2,400,000 appropriation in the Biofuels Energy system Account.

Mr. Davis. The FY 1990 appropriation supports research on advanced electrolysis, thermal reduction of wet biomass in supercritical water, development of improved cell components for cost-effective solid polymer electrolyte water electrolysis systems, photoelectrochemical hydrogen production, improved hydrogen liquefaction systems, safety of various hydrogen production and gaseous hydrogen storage and transportation systems, multilayered photoelectrochemical films to split water, assessment of nitrogenase and hydrogenase producing bacteria that split water, photochemical and photobiological processes, hydrogen storage on metal hydrides and activated carbon and systems analysis. My staff is currently developing a multi-year program plan for hydrogen. When the internal review is complete, industry and the private sector will be asked to provide input prior to its finalization as a guiding document. To my knowledge this will be the first time that the Renewable Energy hydrogen program has had a peer-reviewed guiding document that provides a coordinated research and development strategy and an end goal.

Mr. Akaka. What work remains to be performed under this research program?

Mr. Davis: Before hydrogen can be a viable energy source, research in all its facets --that is, production, transportation, storage, and utilization-- will be needed. To achieve its environmental promise, the supply of hydrogen principally must come from the use of solar energy to split water. Using a fossil fuel to produce hydrogen retains all of the greenhouse and acid gas

concerns of gasoline production and utilization. Although water is one of the most abundant resources on earth, the physical laws of nature require that more energy is needed to break the hydrogen/oxygen bond and liberate hydrogen than is obtained from combusting the liberated gas. Therefore, research should and is being focused on defining the technological and economic boundaries of hydrogen production as a first priority. There are a number of technologies to be evaluated. A popular approach uses a renewable source of electricity such as photovoltaics and an electrolyzer to split water. A second type of approach uses solar energy directly to split water, either by photoelectrochemical reactions or by organisms that produce enzymes in their life cycle that split water. At this point there is not sufficient knowledge upon which to base a choice of technology for a program focus. Therefore the research program is directed at developing the information to make such a choice.

Mr. Akaka. Mr. Davis, the FY 1988 appropriation for Biofuels Energy Systems contains an appropriation of $2,400,000 "to be made available equally to the Hawaii Natural Energy Institute," and three other research institutions. With respect to this appropriation, identify:

(1) amounts dispersed to HNEI

(2) amounts dispersed to entities other than HNEI; and

(3) amounts yet to be disbursed to HNEI or entities other than HNEI from this appropriation. In identifying each amount, list the date of each disbursement and the specific research activities to be performed.

Mr. Davis. I would be pleased to provide a table as an insert to the record. (Insert follows)

TABLE
Status of Hydrogen Research and Funding in FY 1988

HAWAII NATURAL ENERGY INSTITUTE

Research Areas:
- o Preparation and characterization of materials for use in photoelectrodes which use solar energy to split water.
- o Electronic and electrochemical characterization of photoelectrodes for splitting water.
- o Solar energy conversion of water to hydrogen using cyanobacteria.
- o Storage of hydrogen using non-classical metal complexes

Funding Disbursement Date	Remarks	Contract Amount	Invoiced	Paid
FY 1988		$401,999		
8/11/89			64,750.84	64,750.84
8/15/89			24,647.24	24,647.24
11/17/89			23,710.13	23,710.13
12/11/89			118,342.10	118,342.10
12/20/90			40,849.98	40,849.98
1/23/90	$1989.90 withheld for reports		34,975.60	32,985.70
2/27/89			20,246.98	20,246.98
Total			$327,513.77	$325,523.87

TEXAS A&M

Research Areas:

- o Development of practical triple-stacked photocells.
- o Development of thin-film systems that use active organic layers containing photosensitive dyes to collect energy for splitting water.
- o Development of basic work to enhance an understanding of oxygen evolution.
- o Identification of biological producers of hydrogen.
- o Development of improved cell components for cost-effective solid polymer electrolyte systems.

Funding Disbursement

Date	Remarks	Contract Amount	Invoiced	Paid
FY-1988		$400,000		
3/7/89			65,753.64	65,753.64
3/7/89			30,270.96	30,270.96
6/28/89			30,219.29	30,219.29
7/26/89			49,593.06	49,593.06
7/26/89			63,985.63	63,985.63
8/11/89			91,033.72	91,033.72
8/11/89	$4000 withheld for reports		46,793.36	42,793.36
12/6/89			26,350.36	26,350.36
Total			400,000.00	396,000.00

FLORIDA SOLAR ENERGY CENTER

Research Areas:

- o Photoelectrochemical hydrogen production using particulate semiconductors.
- o Chemical storage of hydrogen on metal complexes.
- o Hydrogen systems analysts.

Funding Disbursement

Date	Remarks	Contract Amount	Invoiced	Paid
FY-1988		$400,000		
3/29/89			19,220.53	19,220.53
7/21/89			64,474.53	64,474.63
7/21/89			22,927.95	22,927.95
7/21/89			22,639.12	22,639.12
8/1/89			27,607.23	27,607.23
9/8/89			43,889.66	43,889.66
11/2/89			34,865.49	34,865.49
12/20/89			35,596.93	35,596.93
12/20/89			38,113.64	38,113.64
1/23/89			33,134.80	33,134.80
2/27/90			34,999.85	34,999.85
2/27/90			22,530.27	22,530.27
Total			$400,000.00	$400,000.00

UNIVERSITY OF MIAMI

Research Areas:

- o Hydrogen systems analysis
- o Biological Hydrogen production including characterization of enzyme systems, elucidation of electron donor system, and measurement of photoactivity
- o Improved hydrogen liquefaction systems

Funding Disbursement

Date	Remarks	Contract Amount	Invoiced	Paid
FY-1988		$400,000		
7/24/89			188,757.62	188,757.62
7/31/89			44,490.11	44,490.11
9/8/89			50,630.97	50,630.97
9/28/89	Withheld $4000		52,936.47	48,936.47
11/2/89			31,683.46	31,683.46
Total			368,498.63	364,498.63

SERI

Research Areas:

- o Management of the Renewable Hydrogen program
- o Overhead for the Renewable hydrogen program
- o Inhouse research on photoelectrochemical films

Funding Disbursement

Date	Remarks	Contract Amount	Invoiced	Paid
FY 1988		558,000	$558,000	$558,000

HEADQUARTERS

Areas:

- o General reduction
- o Small Business Innovation Research
- o Technical evaluation and assessment activities.

Funding Disbursement

Date	Remarks	Contract Amount	Invoiced	Paid
FY 1988		240,000	$240,000	$240,000

Mr. Akaka. Mr. Davis, the FY 1989 appropriation for Biofuels Energy Systems contains an appropriation of $2,400,000 "to be made available equally to the Hawaii Natural Energy Institute, "and three other research institutions. With respect to this appropriation, identify: (1) amounts dispersed to HNEI (2) amounts dispersed to entities other than HNEI; and (3) amounts yet to be disbursed to HNEI or entities other than HNEI from this appropriation. In identifying each amount, list the date of each disbursement and the specific research activities to be performed.

Mr. Davis. I would be pleased to provide a table as an insert to the record.

TABLE
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HAWAII NATURAL ENERGY INSTITUTE

Research Areas:

- o Preparation and characterization of materials for use in photoelectrodes which use solar energy to split water.
- o Electronic and electrochemical characterization of photoelectrodes for splitting water.
- o Solar energy conversion of water to hydrogen using cyanobacteria.
- o Storage of hydrogen using non-classical metal complexes

Funding Disbursement

Date	Remarks	Contract Amount	Invoiced	Paid
FY - 1989		$400,000	-0-	-0-

TEXAS A&M

Research Areas:

- o Development of practical triple-stacked photocells.
- o Development of thin-film systems that use active organic layers containing photosensitive dyes to collect energy for splitting water.
- o Development of basic work to enhance an understanding of oxygen evolution.
- o Identification of biological producers of hydrogen.
- o Development of improved cell components for cost-effective solid polymer electrolyte systems.

Funding Disbursement

Date	Remarks	Contract Amount	Invoiced	Paid
FY-1989		$400,000		
12/6/89			22,744.76	22,744.76
12/6/89			39,282.08	39,282.08
12/20/89			45,592.46	45,592.46
1/17/90			34,813.31	38,813.31
-	Held Pending receipt of deliverables.		23,307.83	-0-
			20,786.59	-0-
Total			$186,527.03	$107,619.30

FLORIDA SOLAR ENERGY CENTER

Research Areas:

- o Photoelectrochemical hydrogen production using particulate semiconductors.
- o Chemical storage of hydrogen on metal complexes.
- o Hydrogen systems analysts.

Funding Disbursement

Date	Remarks	Contract Amount	Invoiced	Paid
FY-1989		$400,000		
2/27/90			16,412.40	16,412.40

UNIVERSITY OF MIAMI

Research Areas:

- o Hydrogen systems analysis
- o Biological Hydrogen production including characterization of enzyme systems, elucidation of electron donor system, and measurement of photoactivity
- o Improved hydrogen liquefaction systems

Funding Disbursement

Date	Remarks	Contract Amount	Invoice	Paid
FY - 1989		$400,000	-0-	-0-

SERI

Research Areas:
- o Management of the Renewable Hydrogen program
- o Overhead for the Renewable hydrogen program
- o Inhouse research on photoelectrochemical films

Funding Disbursement

Date	Remarks	Contract Amount	Invoiced	Paid
FY 1989		558,000	$558,000	$558,000

HEADQUARTERS

Areas:
- o General reduction
- o Small Business Innovation Research
- o Technical evaluation and assessment activities.

Funding Disbursement

Date	Remarks	Contract Amount	Invoiced	Paid
FY 1989		$240,000	$240,000	$240,000

Statement of J. Michael Davis
Assistant Secretary for Conservation and Renewable Energy
U.S. Department of Energy
FY 1991 Appropriations Hearings

Mr. Chairman and members of the Committee, I am pleased to present the FY 1991 budget request for Renewable Energy Programs.

At the President's direction, the Secretary of Energy has initiated the development of a National Energy Strategy (NES). The strategy is designed to provide direction for the Department's future policy and funding initiatives. It will provide a comprehensive, long-range strategy for addressing the Nation's near-, mid- and long-term energy needs. The strategy will be based on public input through hearings, written submissions and publicly available reports, all aimed at reconciling our need for secure, competitively priced supplies of energy with environmental, safety and health requirements. An interim report based on the findings from the public hearings will be presented to the President in April 1990. Following this report, the Department will conduct additional hearings to identify the appropriate options to recommend to the President in our final report in December.

Although the NES is not yet complete, public input suggests a broad consensus for increasing emphasis on energy efficiency and renewable energy programs. Accordingly in FY 1991, we are requesting an increase in conservation and renewable programs by 8 percent over FY 1990 appropriations and by 78 percent over the FY 1990 request.

We are proposing a research and development program that is focused on the needs of the market place in the short, mid, and long term. We propose these

steps in the hope of encouraging Federal, State, and local government as well as private sector support for renewable energy. Our success will be based on our ability to accomplish the following:

- Increase diversity of competitively priced energy supplies, benefiting our energy security.
- Improve environmental quality associated with energy production.
- Transfer our research achievements from the laboratory to the factory, benefiting our international competitiveness, productivity, and standard of living.

The request before you is for $176.8 million, an increase of 55 percent over our request last year and 27 percent over our the FY 1990 appropriation. I would like to summarize what I consider to be the highlights of the proposed renewable energy program, beginning with the electrical generating sector.

RENEWABLE ENERGY FOR ELECTRIC POWER

Renewable energy currently provides 9 percent of the Nation's total energy supply and 12 percent of our domestic electrical energy generating capacity, trailing only coal and nuclear energy in our fuel mix. Future growth in the demand for electricity will provide an opportunity for renewables to compete with other technologies for both peak and base load power generation. Many regions of the country are operating on low reserve margins, and without intensive conservation efforts, the U.S. may need to add as much as 100,000 megawatts of electrical capacity by the turn of the century.

There is a range of renewable energy technologies available to help meet our future electric generation needs. Figure 1 is a table listing the key

renewable technologies that are currently under development in the Department. For each of these technologies we project the time scale when these technologies might be available, assuming an aggressive development path.

Figure 1. Time Scale of Technology Availability

DOE Renewable Energy Technologies
for Electricity Generation

(B = Base Load, P = Peak Load & Fuel Saver, L = Load Leveling)

Technology	Short Term (1995)	Mid Term (1995-2005)	Long Term (>2005)
Biomass:			
Municipal Solid Waste	B		
Geothermal:			
Hydrothermal	B		
Solar Thermal:			
Parabolic Troughs	P	B*	
Parabolic Dish		B*	
Central Receiver			B*
Wind:	P		B*
Photovoltaics:			
Thin Films		P	
Concentrators		P	
Multijunction			B*
Storage:			
Electrochemical		L	
Superconducting			L
Hydrogen			L

*Integrated energy systems with storage, or as hybrids with natural gas.

For renewable technologies addressing the electric generating sector, the FY 1991 budget request totals $119.5 million, as compared to the FY 1990 appropriation of $105 million. The request will support ongoing core research efforts in photovoltaics, wind, solar thermal electric, advanced geothermal, and electrochemical storage necessary to advance these options toward commercial viability. Certain research paths, as for example in ocean thermal

energy conversion, are being deferred as part of our effort to sharpen our research focus, and work in the Solar Buildings area is being consolidated with ongoing buildings work under Energy Conservation.

In addition, the budget includes funding for two proven options in need of immediate assistance. Participants in the National Energy Strategy process pointed out that hydropower and energy from municipal waste are caught in regulatory tangles to such an extent that their future contribution is in question. Some 3,000 megawatts of installed hydropower capacity is scheduled for relicensing over the next ten years, making more acute the need to establish a predictable and factually oriented set of licensing requirements. We have therefore proposed a $1 million effort to characterize the hydropower resource, regulatory process, and technical requirements; and $2.5 million to fully characterize the energy and environmental outputs of municipal waste combustion, disposal, and recycling. We believe that these efforts will establish an improved factual basis for planning and regulating these energy resources and will serve as a catalyst to draw together the many involved interests, in order to reach a consensus on the appropriate balance between competing policy objectives.

Geothermal energy resources are among the largest energy resources available to the U.S., and hydrothermal systems are beginning to make a significant contribution, providing 7 percent of California's electrical energy supply. There are, however, a number of technical risks constraining the substantial hydrothermal resource from meeting its short- and mid-term potential for base load electric power, and we are focusing our research effort on those risks, with a $4.4 million (or a 40 percent) increase in hydrothermal R&D aimed at

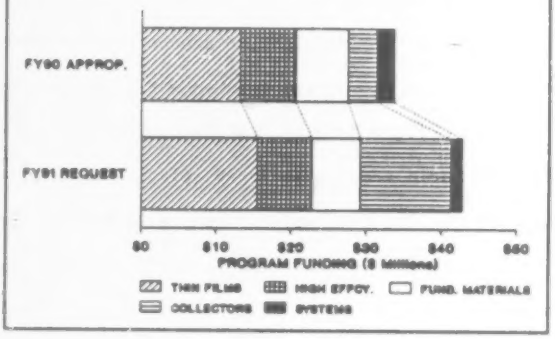
improving reservoir exploration, drilling, and management technologies. Longer-term geothermal research in magma is being deferred.

The photovoltaic (PV) energy program has achieved success in meeting its technical milestones through a combination of strong research and a cost-shared cooperative development program with industry. This public-private cooperative effort achieved seven world records for conversion efficiency in 1989. More significantly, the U.S., for the first time in five years, regained world leadership in PV sales from Japan. We believe that industry, supported by the right mix of R&D, will be in a position to compete for future peak load capacity by the mid term. As technology advances are made and as photovoltaics are supported by effective energy storage or hybrid systems, we expect the industry to begin to compete for future intermediate and base load power requirements. Our FY 1991 request responds to these opportunities with a $43.6 million proposal that would augment continuing core research and development with initiatives designed to more effectively translate laboratory advances into industrial commercial practice and help the PV industry reduce manufacturing costs, in order to open new markets.

Within the PV collector research subprogram, we propose a $9 million effort in FY 1991, to be matched with industrial co-investment, to develop the critical process engineering and manufacturing technology necessary to achieve major breakthroughs in manufacturing efficiency and materials utilization. Within this same subprogram, we are including a $2.5 million collaborative effort to join with industry in optimizing the concentrator technical advances that have been achieved to date in laboratory settings. In addition, within the advanced thin film subprogram, we propose to continue to augment the amorphous

silicon collaborative effort, with a companion $2.5 million undertaking to develop higher efficiency advanced thin film options. Each of these efforts will continue for the program's dual thrust of laboratory research coupled to joint R&D projects with industry, and will support the industrial deployment of photovoltaic energy systems in both distributed and central station applications in the mid-term. The proposed distribution of effort in the PV program is summarized in Figure 2.

FIGURE 2. PV PROGRAM EMPHASIS



Nationally, we lose about 8 percent of the total electrical energy we generate in the transmission and distribution grid. High-temperature superconductivity (HTS) may one day eliminate many of these losses and may lead as well to highly efficient generators, storage devices, and motors. Recent advances in this area have led to a worldwide technological race, with huge potential markets at stake. To support U.S. industry in exploiting the potential of HTS, the Department has coupled laboratory applied research efforts with an innovative mechanism to foster industrial development of new HTS technology, through HTS Pilot Centers that seek cooperative R&D projects with the private sector. The initial response to the Pilot Centers has been very encouraging. In little more than a year, the three Pilot Centers have engaged in 20 collaborative agreements representing an industrial investment of $5.8 million

in return for a DOE investment of $4.5 million. In addition, we believe that industrial participants have committed substantial additional resources in areas related to these collaborations, outside the formal agreements. The progress and the widescale industrial response to date warrant an increase in this subprogram from $12 million in FY 1990 to $21 million in FY 1991, including increased support for the HTS Pilot Centers from $6 million in FY 1990 to $15 million in FY 1991.

RENEWABLE ENERGY FOR TRANSPORTATION

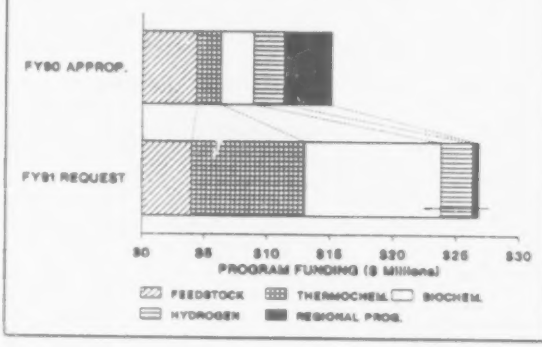
The U.S. transportation sector depends on petroleum for nearly 95 percent of its fuel requirements; it represents a singularly important opportunity for renewable energy to make strategic contributions in support of national security, environmental, and productivity goals. Even assuming reasonable levels of further efficiency improvements, the increasing number of vehicles and total miles driven annually suggest that petroleum demand may increase between 7 and 22 percent over the next 15 years without development of alternative fuels and propulsion systems.

Our FY 1991 request for renewable energy technology to meet transportation sector needs totals $30.9 million, almost double our FY 1990 request, and seeks to establish biomass-derived alcohol fuels as viable supply options by the turn of the century. The Department also seeks to develop the supporting hydrogen and fuel cell technologies which will be instrumental to the widespread attractiveness of biomass-derived alcohol fuels through the long term.

Approximately one third of the U.S. output of carbon dioxide (CO_2) comes from the combustion of petroleum for transportation. Among the many alternatives we have available, one is unique in its ability to contribute almost no net CO_2 as a transportation fuel. This alternative would be a program to grow energy crops specifically for transportation fuel, and convert this biomass to alcohol. While the combustion of alcohol does release CO_2, the growth of the energy crops absorbs CO_2 from the atmosphere, yielding a near-zero net effect. Such a program would have the additional benefits of exploiting the productivity of the nation's domestic agricultural and forestry community to achieve pressing energy and environmental objectives, as well as the chemical engineering expertise of the oil refining industry.

Within the overall ($28 million) biofuels request for FY 1991, we are proposing $22.8 million for research to convert biomass feedstocks into ethanol fuels through biochemical conversion and to methanol fuels through thermochemical conversion.

FIGURE 3. BIOFUELS PROGRAM EMPHASIS



Therm_chemical research ($9.0 million) will emphasize laboratory-scale gasification experiments necessary to define the practicable achievable limits to the process, and to begin development of the gas cleanup technology necessary to effectively reduce impure methane-rich, hydrogen-poor gas streams

to methanol. Biochemical research ($10.8 million) will emphasize the development of advanced yeasts through genetic engineering and development of the simultaneous saccharification and fermentation processes critical to cost-effective ethanol production.

The biofuels request additionally includes $2.0 million to address the principal production and storage constraints currently limiting the viability of hydrogen as a component of the biomass-to-methane-to methanol cycle in the mid term and limiting the economic viability of hydrogen as a more broad-based long-term energy carrier. Finally, we will be working with the Department of Agriculture to draw on its expertise relating to crop and forestry development and to incorporate biofuels technology into its extensive technology transfer networks.

Also in the transportation context, the FY 1991 request for Energy Storage includes an additional commitment of $5.4 million to move Proton Exchange Membrane fuel cells forward on the development cycle. The request will support research aimed at achieving the higher power density, and improved thermal and water management processes, necessary to undertake component and subsystem development within the short to mid term. Over the long term, coupling this technology with an appropriate reformer should make possible a truly flexible propulsion system capable of using methanol, ethanol or hydrogen as a basic fuel source.

RENEWABLE ENERGY FOR THE INDUSTRIAL SECTOR

In the last two years scientists in the Department's research programs have

discovered that concentrated solar energy enhances certain chemical reactions, creating new surface properties in materials and efficiently decomposing complex hydrocarbon chains. One of the potentially most significant applications of this discovery is the solar detoxification of hazardous waste. Initial experiments have shown that many toxins can be broken down into harmless byproducts without the substantial energy costs of the sophisticated incinerators that are now used. This is an application with great potential national importance -- we produce about 280 million tons of hazardous waste each year. To capitalize on this discovery, the Department has completed a small concentrator facility at SERI and modified concentrator facilities at Sandia, to focus sunlight specifically for experiments on these new photochemical processes. In FY 1991 we propose to increase the funding for this R&D effort from $4.0 million (in FY 1990) to $8.6 million.

RESEARCH SUPPORT ACTIVITIES

The FY 1991 renewable energy budget request includes funding for activities needed to support the strengthened and accelerated R&D program. Foremost among these is the need for a new laboratory building at SERI, replacing existing leased space that was originally built as an office building and can no longer support photovoltaic and related materials science research. The new $20 million facility will allow for state-of-the-art research and development and will provide the user facilities needed for the strong cooperative program with industry that is fundamental to the success of the renewables program. For FY 1991, $4.5 million is requested to complete Title I and Title II design, and begin construction.

The FY 1991 budget also includes increased funding for international programs to assist the renewables industry in penetrating overseas markets. The modularity and indigenous nature of renewable energy sources make them attractive candidates internationally, and the increased use of renewable energy in developing countries will pay multiple dividends, including reduced competition for internationally traded oil and a significant contribution to global environmental quality. The U.S. renewables industry is poised to compete for this increasing market, and the international program under the auspices of the interagency Committee on Renewable Energy Commerce and Trade (CORECT), will work to help industry capitalize on these opportunities, with a particular focus in FY 1991 on markets in Pacific Rim nations.

SUMMARY AND CONCLUSIONS

Mr. Chairman, in conclusion, we are proposing a balanced yet aggressive program in renewable energy research and development, and we have some very exciting initiatives under way. We are redirecting our program to play the key role it deserves in our emerging National Energy Strategy, and together with our program in energy efficiency, we are investing in critical components of our energy future.

We have tried to assess the relative benefit of these varied components and fund them accordingly, by end use and by time frame. We will continue to improve our understanding of relative benefit with each succeeding year. Your support in providing the flexibility needed to manage the program is critical in this regard.

I appreciate your time and attention, and I would be pleased at this time to answer any questions you may have.

Thank you very much.

Statement of Peter N. Brush
Acting Assistant Secretary for Environment, Safety and Health
Department of Energy
FY 1991 Appropriations Hearings

Mr. Chairman and members of the Subcommittee, I am pleased to be here today to discuss with you the Department of Energy's (DOE) FY 1991 budget request for the Office of Environment, Safety and Health.

In the past year, Secretary Watkins has charted a new course for DOE and has made a substantial beginning towards instilling a new culture within the Department -- one that recognizes DOE's responsibilities to preserve our environment, protect public and worker health and safety, and assure the Nation's security.

A new management structure has been put in place to provide internal environment, safety and health oversight by the Department of Energy line managers on a day-to-day, shift-by-shift basis, buttressed by continuing and frequent external and internal independent oversight. Line management must be held wholly accountable for environmental protection, safety and health. The principal task of independent oversight must be to promote the achievement of environmental protection and safety by line management.

On June 27, 1989, the Secretary announced a Ten Point Plan to move the Department aggressively toward full accountability and compliance in the areas of environment, safety and health.

The Ten Point Plan:

- Revamped the system of contractor award fees -- compliance with environment, safety and health requirements now constitutes 51 percent of the contractor's award fee evaluation. This is a significant departure from past practices where production took precedence over environmental, safety and health concerns.

- Established independent "tiger teams" to conduct comprehensive environment, safety and health compliance assessments.

- Provided access to DOE nuclear facilities for State officials monitoring environmental, safety and health compliance.

- Moved to strengthen technical capabilities of line management and oversight personnel.

- Mandated compliance with OSHA standards in all DOE facilities.

- Appointed an independent advisory panel to evaluate changes needed in the Department's epidemiology program.

- Established a new management team within the Department's Office of Defense Programs to emphasize safety.

- Directed the development of a Five-Year Environmental Restoration and Waste Management Plan, consolidating cleanup activities and establishing an agenda for compliance and cleanup against which progress can be measured.

- Began development of a comprehensive epidemiology data repository containing information on past and present DOE workers that may be used by qualified researchers.

- Directed a comprehensive review of the Department's NEPA policy, including recommendations for appropriate revisions.

The Secretary has also put into action a number of management reforms that will improve the Department's overall performance and in particular its environmental, safety and health performance. The management reforms that were implemented augment the external oversight that the Department is subject to through the Advisory

Committee on Nuclear Facility Safety and the Defense Nuclear Facilities Safety Board. Highlights of these reforms are as follows:

- Established a new line management system of direct line responsibility and accountability.

- Established Nuclear Self-Assessment Offices within NE, DP and NPR, reporting directly to the Program Secretarial Officer, to perform independent design, construction and operational evaluations of nuclear facility safety. These offices will separately check, on a sample basis, the nuclear safety performance being achieved and will not have production responsibilities.

- Established the Office of Environmental Restoration and Waste Management called for in the Five-Year Plan.

- Replaced the contractor at Rocky Flats with a contractor more attuned to the Department's new emphasis on the environment.

- Realigned the reporting relationships at Savannah River so that special attention will be focused on management of the reactor restart initiative.

- Established a new Office of Nuclear Safety with broad monitoring and auditing capabilities to advise whether line management is adequately assuring nuclear safety. The Office of Nuclear Safety will also carry out enforcement activities associated with the civil and criminal penalty authority of the Price-Anderson Amendments Act of 1988. This office will have no line authority.

- Improved incident reporting at DOE facilities.

MISSION

The Secretary's management reforms, Ten Point Plan and several other initiatives, coupled with the establishment of the Defense Nuclear Facilities Safety Board and the continued support of the Advisory Committee on Nuclear Facility Safety, have resulted in some changes in the responsibilities of the Office of Environment, Safety and Health. Responsibility for nuclear reactor and non-reactor nuclear policy development has been transferred to the Assistant Secretary for Nuclear Energy. In accordance with the establishment of line responsibility, the Assistant Secretary for Defense Programs and the Assistant Secretary for Nuclear Energy are responsible for the safe operation of all facilities under their jurisdiction. Nuclear safety oversight is provided by the new Office of Nuclear Safety, the new Defense Nuclear Facilities Safety Board, and the Advisory Committee on Nuclear Facility Safety. The Office of Environment, Safety and

Health will continue to perform oversight in the areas of environmental protection, radiation safety, worker safety, non-nuclear facility safety, emergency preparedness, and those aspects of public health and safety that deal with epidemiology and radiological protection at DOE facilities. This applies both to defense and non-defense facilities.

Implementation of the Secretary's management and organizational changes are a high priority in the Department, but will take some time to complete. During the transition, responsibilities and authorities for oversight will continue to be exercised in accordance with current directives until a phased reassignment of functions is possible. Once in place, this management and organizational structure will enhance environmental protection and safety, expand oversight, and provide a more secure base from which to achieve our national security and energy missions.

In addition, the Office of Policy, Planning and Analysis, through Departmental reorganization, has acquired the leadership role for environmental analysis of national and international environmental issues that affect U.S. energy supply, demand and prices. This includes for example, analysis of legislative and regulatory change at the national level and global climate change at the international level.

PLANNED FY 1990 ACCOMPLISHMENTS

As a direct result of the Secretary's Ten Point Plan, the Office of Environment, Safety and Health is focusing on a number of new priority efforts. A program of independent "Tiger Team" compliance assessments has been started to assure compliance with applicable environment, safety and health requirements. These assessments form the cornerstone of the Department's overall plan to create a new culture of self-assessment and accountability within the Department and are essential to bringing all of the Department's facilities into full compliance with environment, safety and health requirements. Conducting a "Tiger Team" assessment typically requires more than 30 highly skilled and experienced professionals, and could potentially involve four to six weeks of onsite activities as well as three to four weeks of preparation and follow-up activities. We have completed special assessments at the Rocky Flats Plant, Feed Materials Production Center, West Valley Demonstration Project, Y-12 Plant, Pantex Facility, Mound Plant, Portsmouth Gaseous Diffusion Plant, Nevada Test Site, Kansas City Plant, and the Pinellas Plant. Fundamental changes are being made at these facilities to better manage the environment, safety and health programs, and to take a proactive approach in interacting with regulators to address environmental concerns identified by the Department.

In order to improve assessment capabilities we have developed a one-week training course for "Tiger Team" assessments. This course, along with a Tiger Team Guidance manual currently under development, and field and program office participation on the "Tiger Teams" will assist the entire DOE system in performing the self-assessments necessary for operational excellence.

Also as a part of the Ten Point Plan, we are establishing an aggressive DOE program in the area of occupational safety and health and providing an integration of DOE's epidemiology programs and worker safety and health programs. Efforts are also underway to provide increased emphasis to the relationship of radiation protection, medical surveillance and epidemiology studies. Through an agreement with the Occupational Safety and Health Administration (OSHA), OSHA compliance officers have participated in defense nuclear facility inspections and OSHA is helping us to establish a comprehensive training program so DOE can more effectively monitor workplace safety in such areas as workplace hazard evaluations, and workplace compliance reviews. We are also discussing an OSHA review of our worker safety oversight program.

Improving the Department's compliance with the National Environmental Policy Act (NEPA) is a high priority also. In announcing his Ten Point Plan, the Secretary stated that the Department's NEPA process was decentralized and lacked consistency. A comprehensive review of

the Department's NEPA policy has been completed. A new NEPA policy was recently approved that underscores the Secretary's personal commitment to protection of the environment and compliance with NEPA. Among other things, the policy affords early involvement of host-State Governors in the NEPA process, and directs revisions in the Department's NEPA practices which will ensure that the public, and DOE, are better informed regarding proposed DOE projects. DOE will issue proposed revisions to its NEPA Guidelines as draft rules for public comment. When finalized, the DOE procedures for NEPA compliance will be codified for the first time as DOE regulations.

As part of the Secretary's organization and management reforms, in the very near future the Assistant Secretary for Environment, Safety and Health will be assuming responsibility for inspecting and assessing the effectiveness of the Department's safeguards and security policies, programs, and implementation in the field, and for the safety certification of packages for shipment of DOE radioactive materials. This program is currently in the Office of Defense Programs and is therefore covered in Defense Programs' FY 1991 budget request.

FY 1991 BUDGET REQUEST

The FY 1991 budget request for the Environment, Safety and Health program is $97.4 million, an increase of nearly $11 million over

the FY 1990 appropriation, as adjusted to reflect the organizational realignments discussed previously. Our budget proposal fully reflects Secretary Watkins' priority emphasis on environment, safety and health oversight. A summary table of our FY 1991 budget request is included at the end of this statement.

FY 1991 BUDGET HIGHLIGHTS

Environmental Audit ($12 million): The goal of the Environmental Audit Program is to provide comprehensive oversight of the Department's operating facilities to ensure compliance with all applicable environmental requirements and to reduce areas of existing or potential environmental risk. In FY 1991, "Tiger Team" Compliance Assessments will be performed at approximately 20 facilities and compliance assessment training for line management will continue. Environmental audits will be conducted at 8 sites.

Environmental Guidance and Compliance ($10 million): The Environmental Guidance and Compliance function provides environmental policy and technical guidance to DOE operations for implementation of applicable environmental requirements, and provides oversight and coordination of Departmental compliance activities. Major activities planned for FY 1991 include support to implementation of the Environmental Restoration and Waste Management Five Year Plan, follow-up to ensure appropriate actions are taken in response to findings from the environmental audits, and technical and policy

guidance for establishment of compliance agreements with the States and EPA. In response to the Secretary's initiatives for setting a "new course", major environmental training initiatives are planned in addition to those started in FY 1990 to ensure that personnel at all levels are fully prepared to meet environmental requirements at DOE facilities.

NEPA Project Assistance ($6 million): The NEPA Project Assistance Program performs ongoing NEPA functions, including project review and technical assistance, and has lead responsibility for implementing the Secretary's new NEPA policy. The workload of the NEPA Project Assistance Program will continue to increase significantly as a direct result of the new NEPA policy initiatives and the Department's increasing project development activities, such as modernization of the defense complex.

Environmental Analysis ($5.4 million): As stated previously, the Environmental Analysis Program has recently been transferred to the Office of Policy, Planning and Analysis. Their FY 1990 accomplishments and plans for FY 1991 will be presented to the Subcommittee on March 15, 1990 by Linda G. Stuntz, Deputy Under Secretary.

Medical Director ($0.9 million): The Medical Director has Departmental responsibility for providing occupational medicine program oversight for all DOE government-owned contractor-operated

facilities and assuring that DOE contractor employees at these facilities are provided medical care within Department standards. The Department has one of the largest occupational medicine programs in the world, comprised of 48 contractor occupational medical departments located at DOE facilities, and employing 120 occupational physicians and some 2,000 ancillary occupational health specialists. During FY 1991, this program will continue to perform onsite reviews of field office and contractor medical programs, and will provide support to our efforts to improve radiological protection programs throughout the Department.

Safety Appraisals ($17.5 million): The Safety Appraisal Program provides independent oversight to assure that DOE's safety responsibilities are properly fulfilled. Under the Secretary's realignment of safety functions, during FY 1990, the Safety Appraisal Program will transition from an emphasis on nuclear facility safety to one of non-nuclear facility safety, worker safety and radiological protection. During the transition, we are continuing to perform comprehensive Technical Safety Appraisals of nuclear facilities in conjunction with the Tiger Teams. In FY 1991, our safety appraisal program will start to focus on multidisciplinary team safety appraisals, management reviews and functional appraisals and other engineering assessments (exclusive of nuclear facility safety) in order to verify compliance with Departmental safety policies, standards, guidance and good practices.

Safety Compliance ($2.2 million): The mission of the Safety Compliance Program is to monitor corrective action programs developed in response to deficiencies identified by EH safety appraisals and to provide an overall diagnostic assessment of DOE line management's safety program performance at DOE facilities and operations. During FY 1991, the Safety Compliance Program will provide followup on non-nuclear facility safety, worker safety and radiation protection safety issues. In addition, conduct of performance assessments and trend analysis will continue. DOE-wide safety and health training programs to inform and educate DOE personnel on safety techniques and their application will also continue.

Quality Programs ($8.2 million): Quality Programs is the focal point for safety-related quality assurance, non-nuclear safety expertise and onsite monitoring of safety and health. In FY 1991, Quality Programs will emphasize development of DOE-wide worker safety programs, including training programs, to ensure that the Department is in compliance with applicable OSHA and DOE requirements. Residents on-site at DOE facilities will continue to make technical observations to assure that safety and health issues and problems are promptly brought to DOE management's attention.

Safety Policy and Standards ($3.4 million): The overall mission of the Safety Policy and Standard's Program is to develop DOE non-

nuclear safety, radiological protection and emergency preparedness policies and standards. The Secretary's realignment of functions has relieved this program of its responsibilities in the areas of nuclear safety policy and DOE national emergency response capability (i.e., the Atmospheric Release Advisory Capability and the Aerial Measurement System) -- hence, the significant change in the budget for this program. In FY 1991, the Safety Policy and Standards Program will be concentrating on the development of non-nuclear safety and radiological protection policies and standards, and oversight of radiation protection and emergency preparedness.

Facility Operator Training and Assistance Program ($4.4 million): FOTAP supports facility personnel training programs through provision of facility-specific resources to develop performance based training for operations and support personnel. In addition, a graduate fellowship program to provide the requisite professional/technical capability to DOE and its operating contractors in radiation protection has been included as a long term effort to attract and recruit professional radiation protection engineers and scientists.

During FY 1991, funds requested will also be used to implement performance-based training development in radiation protection and worker safety.

Planning and Information Resources Management ($4.1 million): Commensurate with the priorities reflecting the importance of protecting the environment, ensuring safe operations and maintaining the health of workers and the public is the need for an integrated environment, safety and health data base. The current EH system is available on-line to over 500 DOE and contractor registered users. Funds requested would be used for continued management and administration of the system, integration of EH data bases with those maintained by Defense Programs and the Environmental Protection Agency, and for unanticipated environmental, safety and health planning activities.

Program Direction ($21.7 million): The Program Direction account provides funds for salaries, benefits, and travel for the staff complement of the Office of Environment, Safety and Health, as well as funds for support contracts that furnish centralized administrative and technical services to the full range of Office functions. Funds requested would support 269 FTE's and associated travel for EH and other program Federal employees involved in "Tiger Team" Compliance Assessments, audits and appraisals, as well as an increased reliance on contractor support for administrative services. This will allow us to hire additional technical staff critically needed to support our oversight programs.

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Capital Equipment ($1.5 million): Capital equipment funds are requested to support the DOE laboratory accreditation program -- a program designed to improve worker radiation protection through independent verification and certification of DOE capabilities for radiological monitoring and assessment; applied health physics research and development focused on solving operational problems identified by internal and external reviews of DOE sites; personal computer workstations and software for EH employees; and for various other items such as test and calibration equipment in support of fire protection programs and upgraded respiratory protective clothing.

This concludes my prepared statement. I would be pleased to answer any questions from the Committee.

DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(dollars in thousands)
LEAD TABLE
Environment, Safety and Health

Activity	FY 1989	FY 1990 1/	FY 1991 Base 2/	FY 1991 Request	Program Change Request vs Base Dollar	Program Change Request vs Base Percent
Environmental Audit	$17,000	$9,600	$8,375	$12,000	$3,625	43
Environmental Guidance & Compliance	4,300	8,400	8,400	10,000	1,600	19
NEPA Project Assistance	2,900	4,700	4,700	6,000	1,300	28
Environmental Analysis	6,000	4,240	4,240	5,400	1,160	27
Medical Director	700	900	900	900	0	0
Safety Appraisals	12,250	18,033	17,500	17,500	0	0
Safety Compliance	1,100	2,290	2,200	2,200	0	0
Quality Programs	6,000	10,278	10,278	8,200	(-2,078)	(20)
Safety Policy and Standards	19,850	22,570	3,421	3,421	0	0
Facility Operator Training and Assistance Program	--	1,870	1,870	4,400	2,530	135
Planning and Information Resources Management	3,190	3,740	3,740	4,100	360	10
Program Direction	11,400	19,324	19,324	21,758	2,434	13
Capital Equipment	3,100	3,057	1,542	1,542	0	0
Adjustments 3/	3,210	--	--	--	--	--
Total	$91,000	$109,002	$86,490	$97,421	$10,931	13
FTEs 4/	204	269	269	269		

1/ FY 1990 reflects final Gramm-Rudman-Hollings sequester adjustments and P.L. 101-164 reductions to fund anti-drug activities.
2/ FY 1991 base reflects the impact of a Departmental reorganization which shifts responsibility for daily oversight of DOE environment, safety and health functions to line management in the programs.
3/ FY 1989 Adjustments are $210,000 for a general appropriation reduction and $3,000,000 for the transfer of the Advisory Committee on Nuclear Facility Safety to Nuclear Energy.
4/ Excludes FTEs funded by the Nuclear Waste Fund, the Clean Coal Program, and the Advisory Committee on Nuclear Facility Safety. Includes 40 FTEs in FY 1990 and FY 1991 for the Office of Nuclear Safety.

Statement of Leo P. Duffy
Director, Office of Environmental Restoration and Waste Management
Department of Energy
FY 1991 Appropriations Hearings
March 6, 1990

Mr. Chairman, I appreciate the opportunity to appear today to discuss the Department's fiscal year 1991 budget request for Environmental Restoration and Waste Management.

INTRODUCTION

The Department of Energy (DOE) faces the largest environmental cleanup problem among the Federal agencies. For more than 40 years, DOE mainly through its defense production activities, introduced quantities of radioactive and hazardous chemical pollutants into the soil and surface water. These problems resulted from 40 years of emphasis on production, far too often at the expense of the environment. To change this condition, Secretary Watkins has initiated a new operating philosophy at DOE and is implementing a 10-point plan to better manage the Department's responsibilities in the areas of environmental protection, public health, worker safety and waste management. The Secretary's principal guideline is that there must be compatibility between our DOE mission to produce defense materials and the protection of health and the environment. DOE can only be considered successful if we provide the materials necessary for the defense of the Nation without insult to the environment or injury to public and worker health and safety.

ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT FIVE-YEAR PLAN

In March 1989, Secretary Watkins directed the Department to prepare an Environmental Restoration and Waste Management Five-Year Plan as a means of gaining a better understanding of the specific cleanup and compliance criteria required in the near term, as well as the cost of those actions. The initial Five-Year Plan was issued in August 1989 and is the cornerstone of the Department's short and long-term strategy to consolidate and coordinate DOE's cleanup activities. The Five-Year Plan consolidates cleanup activities in the areas of Defense Programs, Nuclear Energy and Energy Research; treats them as a unified program, and establishes an agenda for compliance and cleanup against which progress will be measured.

The Five-Year Plan identifies three specific compliance related activities. "Corrective Activities" denotes activities necessary to bring facilities into compliance with applicable local, State and Federal regulations. "Environmental Restoration" includes the assessment and cleanup of surplus facilities and inactive sites. "Waste Management" involves the treatment, storage and disposal of wastes generated as a result of ongoing operations at active facilities. "Technology Development" of new and improved technologies for waste minimization and cleanup is carried out to support the goals of each of these three areas. The proposed FY 1991 budget closely follows the structure of the Five-Year Plan.

The work in the Five-Year Plan is divided into the following priorities which help to establish the relative order of funding requirements:

Priority 1 - activities necessary to prevent near-term adverse impacts to workers, the public, or the environment.

Priority 2 - activities necessary to comply with existing compliance agreements, in place or in negotiation, between DOE and Federal, State, and local agencies.

Priority 3 - activities required for compliance with external environmental regulations that were not captured in Priority 1 or 2. In addition, provides for compliance with DOE Orders that implement external regulations or set specific DOE regulatory standards.

Priority 4 - activities that are not required by regulation but would be desirable to do and initiatives to meet anticipated future requirements.

PUBLIC REVIEW OF THE FIVE-YEAR PLAN

Secretary Watkins has also created an atmosphere at DOE that is encouraging constructive criticism. DOE invited representatives chosen by the Governors of Colorado, Idaho, Kentucky, Nevada, New Mexico, Ohio, South Carolina, Tennessee, and Washington to review the Environmental Restoration and Waste

Management Five-Year Plan while it was being developed. In addition, the Plan was reviewed by elected leaders of the Yakima Indian Nation from Washington State and the Shoshone-Bannock Tribe from Idaho, representatives from the National Conference of State Legislatures, and the National Association of Attorneys General. The Plan was reviewed for its technical content and approach by the National Academy of Sciences' Board on Radioactive Waste Management. DOE also sought EPA and the Office of Management and Budget views, and has attempted to address the concerns expressed by all of these groups.

An update of the Five-Year Plan is well underway and includes expanded public review. The revised Plan's structure follows the presentation of the existing Plan but adds new sections on Technology Development to direct scientific and engineering resources to address environmental compliance needs and outlines Transportation Management requirements. We are also expanding the external review process. Ten states and two Indian Nations as well as participants from a large cross section of the public including unions, industry associations, public interest groups and environmental groups have been added to expand the external review process. The revised Five-Year Plan will be the subject of public meetings in May 1990.

SINGLE NEW APPROPRIATION ACCOUNT

To formalize the commitment of Congress and the Administration to fund cleanup work adequately, the FY 1991 budget request proposes to establish a separate appropriation account to fund all DOE cleanup and restoration activities and

related technology development initiatives. This budget consolidates cleanup and restoration activities previously funded within Defense programs, Nuclear Energy and Energy Research and that are contained in the Five-Year Plan. Uranium enrichment activities will remain in a separate appropriations account due to the nature of the production and sales revenue environment utilized for uranium supply and enrichment activities. This unified budget presentation should assist in ending the practice of trading off funds for environmental projects with production and other programmatic activities. Establishing a single appropriations account is not intended to change or lessen Congressional oversight of the Five-Year Plan activities. Instead, we consider that this consolidation may assist Congressional oversight by focusing the Five-Year Plan budget request for improved review and examination. A separate appropriations account helps ensure that funds meant for cleanup and environmental restoration will be spent according to the priorities established among competing cleanup projects and not relegated to claim only what remains after DOE production and program needs have been satisfied.

The FY 1991 budget presents, for the first time, a single, focused and unified program which directly relates to the Five-Year Plan. Secretary Watkins established a new line organization within DOE Headquarters last November to manage the program -- the Office of Environmental Restoration and Waste Management -- and appointed me to serve as the Director.

BUDGET OVERVIEW

The budget provides approximately $19 billion for FY 1990-1995 for completing the highest priority activities of the Five-Year Plan (in addition to $0.8 billion for uranium enrichment cleanup). The budget request for FY 1991 will fund activities necessary to prevent near-term adverse health and environmental impacts and ensures that existing compliance or cleanup agreements are maintained. The budget request also provides some additional funds for other important projects to reduce risks, promote compliance, reduce costs, and prevent disruption of the DOE mission. The budget request funds priorities 1,2 and most of 3 of the Five-Year Plan. The FY 1991 adjusted budget request of $2,791 million is $573 million, or 26 percent over the FY 1990 level. This budget continues the rapid acceleration of the cleanup of DOE facilities started by President Bush's allocation of an additional $300 million to the FY 1990 budget request and the Congress's action to appropriate an additional $357 million for FY 1990. The Department is proposing a FY 1991 budget level of $2933 million for Five-Year Plan activities, but recognizes that project slippages estimated at $142 million are likely, given the large number of individual projects (over 1500) and the probable delays in attracting and acquiring the required technical and administrative staff at DOE and in the States to administer this large, complex program. DOE, its contractors and the States are all competing for a very limited talent base which will impact project schedules during the FY 1990-91 timeframe.

The following table summarizes the FY 1991 budget requests.

ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT
FUNDING SUMMARY
(dollars in millions)

	FY 1989 Actual	FY 1990 Appropriations	FY 1991 Request	Percent Change 1991 vs. 1990
Waste Management	$1,095.2	$1,247.7	$1,652.3	+ 32
Corrective Activities	85.0	124.7	168.6	+ 35
Environmental Restoration	419.7	656.8	882.4	+ 34
Technology Development	51.8	183.5	206.0	+ 12
Program Direction	5.5	5.5	24.1	+334
TOTALS	$1,657.3	$2,218.3	$2,933.4	+ 32
Less Adjustment for Slippages			-142.0	
ADJUSTED TOTAL	$1,657.3	$2,218.3	$2,791.4	

This budget is composed of the following major activities:

- **Waste Management** activities comprises the largest portion of the estimate ($1,652.3 million) or 56 percent of the total FY 1991 request. This reflects the costs of constructing and operating waste management facilities.

- **Corrective Activities** represent the smallest component of the costs ($168.6 million). Most of these funding requirements are in the near-term (1990-92) reflecting the need for prompt action to bring operational facilities into compliance with existing standards.

- **Environmental Restoration** funding of $882.4 million is

approximately double the FY 1989 level. This reflects the gradual transition from the investigation and feasibility studies under CERCLA and RCRA to actual remediation projects. Since the ultimate scope and complexity of the restoration projects has not yet been determined, this activity has the greatest degree of cost uncertainty.

- **Technology Development** is essential to the overall cleanup and waste management program by the development of innovative permanent disposal solutions and lower costs. The objective of this activity is to accelerate the conception, creation, development, and deployment of the next generation of environmental cleanup and waste management. A separate research and development (R&D) plan was issued last November which describes the current state of cleanup and waste minimization technologies and establishes milestones for research. The FY 1991 request of $206 million represents approximately 7 percent of the total request. DOE plans to allocate 10 percent of its resources for Technology Development in the outyears but recognizes that some time is needed to build the needed infrastructure to conduct the R&D initiatives. It should be noted that we are engaged in a comprehensive internal and external review of the technology development program needs and priorities. This examination has delayed decisions on the target funding allocations for DOE field offices but this added review time should place the program on a sounder and better planned basis for the future.

- **Program Direction** ($24.1 million) provides for the Headquarters staff responsible for developing policy, administration, budget formulation and execution, long range planning, monitoring and evaluating contractor performance and providing the linkage between the Department and other agencies, Congress, public interest constituencies and the private sector. The FY 1991 request also provides funding for field office staff associated with conducting environmental management activities in certain DOE Operations Offices.

The following provides more details on the FY 1991 budget request for the major program activities which comprise the Environmental Restoration and Waste Management appropriation account.

WASTE MANAGEMENT OPERATIONS

The goal of the Waste Management Operations program is to assure the safe and effective treatment, storage, and disposal of radioactive, hazardous, mixed, and sanitary wastes that result from the Department's nuclear activities. There is a firm mandate to implement an aggressive program to minimize the amount of waste generated by DOE activities in the future. As for all of our programs, these activities are to be carried out in full compliance with all applicable Federal, state, and local requirements.

FY 1991 BUDGET REQUEST
Waste Management

Subactivity	(dollars in thousands) FY 1990	FY 1991
OPERATING EXPENSES:		
Continuity of Operations	$ 264,368	$ 283,262
Waste Isolation Pilot Plant	79,060	112,237
Defense Waste Processing Facility	124,097	128,763
Hanford Waste Vitrification Plant	16,056	25,000
Treatment, Storage, Disposal	359,695	518,021
West Valley Demonstration Project	87,360	90,000
Waste Minimization, Low-level Waste, Program Support	89,455	108,434
Construction and Capital Equipment	$ 227,612	$ 386,595
TOTAL	$ 1,247,703	$1,652,312

The FY 1991 request for the Waste Management Operations program is $1,652,312,000. This is an increase of $404,609,000 over the FY 1990 appropriations. This 32 percent increase reflects an increase of $298,719,000 for activities required to support activities necessary to comply with Resource Conservation and Recovery Act (RCRA)-based hazardous waste management regulations, while meeting required milestones established by formal agreements with the regulator, and to upgrade the conduct of our extensive operations. It also includes an increase of $71,890,000 for initiating construction of the Hanford Waste Vitrification Plant, upgrading an Idaho tank farm, the start of design of a transuranic (TRU) and low-level waste treatment facility at Hanford, and the start of other construction projects. Finally, there is an increase of $34,000,000 for the Plutonium-Uranium Extraction

(PUREX) Plant at Hanford in support of waste management activities beginning in the fourth quarter of FY 1991.

Basis for Managing DOE Wastes

DOE treats and disposes of radioactive waste on DOE-owned property to reduce the likelihood of human and environmental exposure and to reduce potential future liability. Commercial facilities can be considered for treatment of certain wastes. Radioactive mixed waste (RMW) is managed to meet both RCRA's treatment standards for the hazardous components and DOE's performance objectives for the radioactive constituents. DOE Order 5820.2A has established specific requirements to properly transport, handle, and dispose of the radioactive component of the waste streams. This DOE Order issued in September 1988, is directing significant efforts toward adequate waste characterization and waste form testing to determine the adequacy of present and planned treatment, and DOE will design future radioactive waste disposal sites to meet prescriptive objectives stated in the Order.

Mixed Waste and Land Disposal Restricted (LDR) Waste

One area that demands intense effort is the proper management of RMW (wastes containing both a hazardous and radioactive component). Through the amendment to the RCRA in 1984 and the DOE interpretive by-product rule RMW is now subject to both RCRA and the Atomic Energy Act of 1954 (AEA). Requirements for managing certain RMW were enacted before the Department had facilities available to handle the waste. Added communication between Environmental

Protection Agency (EPA) and DOE shows DOE concern that the continued operation of essential defense nuclear materials and weapons production plants may be construed to violate RCRA regulations, in particular the Land Disposal Restricted Waste storage prohibitions in 40 CFR 268.50. There is a lack of available treatment capacity for the LDR streams, and these streams must remain in controlled storage until the wastes can be thoroughly categorized, until permits can be obtained to operate, and until treatment capacity can be built. DOE has voluntarily disclosed this condition to EPA and is establishing agreements with the regulators to enable the Department to continue its defense mission and waste management operations while coming into compliance with all applicable EPA and State regulations.

DOE provided EPA a comprehensive description of all DOE RMW that are now subject to LDR under the RCRA by submitting the National Report on Prohibited Waste and Treatment Options on January 17, 1990. This Report provided specific information that indicated over 30 sites generate or store 221 RMW streams that contain prohibited wastes. Many of these wastes were generated from the production of nuclear materials for defense or research purposes, others from recycling or reprocessing of spent materials. With severely limited capacity to treat these wastes, DOE foresees the need to negotiate specific compliance agreements with the EPA and our host States as we implement the new requirements. Prior to this National Report, we gave EPA a table of all RMW and indicated the lack of available treatment facilities to treat these wastes in order to justify a 2-year extension in setting treatment standards. As the EPA promulgates additional rules, it must be recognized that we are, at times, constrained by the Federal budget process timetable and

may not be able to respond as rapidly as required. Active participation with the regulators assists in educating all parties to institutional and technical constraints.

Waste Isolation Pilot Plant (WIPP)

A year ago the Department had anticipated that the WIPP would be ready to receive waste in the fall of 1989. In June 1989, the Secretary announced that the facility would not be ready to open as planned due to his concern that safety and technical issues were not being addressed adequately. The Secretary called for the development of a new baseline and also established an independent Blue Ribbon Panel (BRP) to review certain WIPP-related issues.

In October, the Department completed a draft Decision Plan on WIPP which identified the activities that need to be completed satisfactorily prior to WIPP receiving waste, the process for conducting these activities, and an estimate of the time required for their completion. DOE solicited comments on its WIPP Decision Plan from the Governors and congressional delegations of Colorado, Idaho, New Mexico, Nevada, South Carolina, Tennessee, and Washington, as well as from the New Mexico Environmental Evaluation Group (EEG), the EPA, the Departments of Defense and Interior, the Office of Management and Budget, the Secretary's Independent Advisory Committee on Nuclear Facility Safety (ACNFS) and other interested parties. The Secretary will not set a date for opening the WIPP facility until he is confident that a series of preoperational activities--many of which are outside of the Department's control--can be completed successfully. Significant progress has

been made in completing many of the prerequisites.

For example, construction of the facility was effectively completed in FY 1989. In August 1989, the Nuclear Regulatory Commission (NRC) granted its Certificate of Compliance for the TRUPACT II shipping container. These containers are being manufactured and the related equipment is being procured. We are also pursuing cooperative efforts with States to assure safe transportation of TRU waste to the WIPP site. The draft Final Plan for the WIPP Test Phase: Performance Assessment was released in December 1989. Comments have been received from the National Academy of Sciences, the EPA, and the EEG. There is general consensus that tests with representative waste in limited amounts should begin without delay. The Plan is expected to be issued in April 1990. The engineering design of the bin tests is underway with fabrication of the bins to be completed this summer. The development of procedures, as well as the capability to characterize the waste to be used in the test phase, is also underway. In January, over 2,000 copies of the Final Supplement to the WIPP Environmental Impact Statement were distributed to members of Congress, State and Federal Agencies, and concerned individuals. Shortly, the Secretary will issue the Record of Decision (ROD) resulting from the analysis of alternatives that were considered. The ROD will also address the recommended option for the operations demonstration.

In the areas of facility operational safety, the WIPP project has made significant progress in the last year. Reviews of the Final Safety Analysis Report (FSAR) by DOE's Office of the Deputy Assistant Secretary for Safety, Health and Quality Assurance have culminated in the issuance of a Safety

Evaluation Report (SER). This SER independently documents the completeness and adequacy of the FSAR in accordance with DOE directives. In addition, reviews have been conducted by the ACNFS, the EEG, and the New Mexico State Environmental Improvement Division. Each of these reviews adds another level of assurance that the WIPP facility's FSAR represents a systematic analysis of the potential hazards associated with operating the facility and that reasonable measures have been taken to eliminate, control, or mitigate the hazards. Completion of this review process is expected this summer.

Another closely related effort is the preoperational readiness reviews. During the last year, these reviews have been conducted by a number of internal as well as external groups to provide independent assessments of the readiness of the WIPP to be operated in a safe manner. The reviews are continuing and are expected to be completed during 1990 in support of initial waste receipt. These reviews will be followed by an integrated systems check out for the bin test program.

A final activity requiring significant effort over the past year has been the preparation and submittal of a No-Migration Variance Petition to EPA in accordance with RCRA provisions. A Final Addendum was submitted to EPA in January. It includes a Waste Analysis Plan which consists of process flow diagrams that detail the hazardous constituents which may be present in the waste streams intended for WIPP throughout the Test Phase as well as an Air Monitoring Plan. A final Retrieval Plan is also being completed. EPA's proposed decision on the petition is expected in April and the final decision in late September.

The current land withdrawal permit issued by the Interior Department for the WIPP project expires in 1991. This permit does not authorize the transportation, storage, and emplacement of radioactive materials at the site. We believe that a legislative solution to the land withdrawal issue would preclude the need for an extension or modification of the current administrative land withdrawal and allow important test programs involving TRU waste to proceed. The Administration currently plans to submit a legislative land withdrawal proposal to Congress shortly which will specify conditions that the DOE must meet before the land withdrawal can take effect, including EPA approval of the Department's No-Migration Variance Petition, the completion of the FSAR and a Supplemental Environmental Impact Statement. The legislative proposal would also address compliance with EPA repository standards.

The proposed FY 1991 budget for WIPP is intended to support operation of the WIPP facility and other related activities to conduct an experimental test program. This program will include bin and alcove radioactive tests, as well as an aggressive program to evaluate possible engineering modifications to address disposal room performance.

Rocky Flats Plant TRU

We have also been deeply involved with the mixed TRU waste storage situation at the Rocky Flats Plant, located near Denver, Colorado. The delays attendant to the WIPP forced us to look at alternate storage sites for the Rocky Flats

waste. We are investigating three options: storage at one or more DOE sites, storage at a Department of Defense facility, and storage at a commercial site. We have considered DOE sites in seven States for such storage (i.e., the Rocky Flats Plant, WIPP, the Los Alamos National Laboratory, the Idaho National Engineering Laboratory, the Oak Ridge National Laboratory, the Nevada Test Site, the Savannah River Site, and the Hanford site).

Waste minimization and volume reduction initiatives have been effective at the Rocky Flats Plant to extend the date when the permitted storage limit would be reached and either plant operations must be curtailed or offsite shipment would have to be initiated. We have been actively seeking the advice and counsel of all States potentially involved and have kept them abreast of our plans and progress. Secretary Watkins is committed to keeping the responsible State officials involved and informed.

High Level Waste Vitrification

We continue to make progress in our plan to transition from tank storage of high-level waste at our Savannah River and Hanford sites, and at the West Valley site for which we have responsibility. We are transitioning from tank storage to more secure and environmentally acceptable storage of a glass waste form encapsulated in stainless steel canisters. The processes proposed for the three vitrification plants is based on the same technology. Also, this technology is being used at waste processing plants in Germany, France, Japan, and the United Kingdom. DOE will take full advantage of the applicable technology development at these facilities. An active technology exchange

program has been established among the three vitrification plants for this purpose. Storage of the vitrified borosilicate high-level waste form will be provided on site until a Federal geologic repository is ready to receive defense waste.

The vitrification plants are being designed and constructed so that they will be in full compliance with Federal, State, regional, and local environmental policies for gaseous, liquid, and solid emissions. Requirements for all applicable environmental laws and regulations will be met.

Defense Waste Processing Facility (DWPF)

The DWPF is located near Aiken, South Carolina. There are approximately 34 million gallons of radioactive waste stored in underground tanks at the Savannah River site. A fraction of this waste will be vitrified at the DWPF. The facility is designed to produce a maximum of 410 glass-filled canisters annually, each of them containing approximately 165 gallons of vitrified waste. Production estimates show that once the facility is fully operational, it will take 16 years to process the backlog of accumulated wastes.

Interim storage of the vitrified high-level waste at the Savannah River Site will be in a glass waste storage building. The storage building can hold 2,300 waste-filled canisters, representing approximately 5 years of DWPF production. Eventually the canisters of glass will be transported to a Federal geologic repository.

The first processing plant at the Savannah River Site, the DWPF, is nearing completion. Construction is currently estimated at 97 percent complete. The total estimated cost for construction is $930.2 million. In FY 1991, preoperational activities will continue in support of the anticipated January 1992 vitrification facility hot startup. The hot startup will be preceded by extensive cold runs using nonradioactive simulated waste. Data from the cold runs will provide necessary information on waste form qualification, quality assurance, and personnel training. Cold runs will be scheduled for 19 months. Cold runs will be followed by review and approval for hot startup estimated to last 6 months.

Projects that provide direct support to the DWPF at the Savannah River Site are the Saltstone Manufacturing and Waste Facility (SMWF) and the Consolidated Incinerator Facility (CIF). The SMWF will treat and process the low-level radioactive salt solution fraction from the DWPF process. It will be stabilized in a concrete matrix and stored onsite in above ground RCRA-approved concrete vaults. The CIF is designed to incinerate liquid and solid hazardous mixed waste materials. The high temperature in the CIF rotary kiln will destroy the volatile hazardous organic waste stream, primarily benzene, generated by the DWPF vitrification process. Radionuclides are immobilized in a concrete matrix for onsite low-level storage. The SMWF is completed, with $9.7 million requested in FY 1991 for startup and operations. The CIF design is undergoing hazard and safety analysis reviews and has a total estimated cost of $63.1 million. Scheduled completion of the CIF is the second quarter of FY 1992.

West Valley Demonstration Project

A similar plant will be the West Valley Demonstration Project located near West Valley, New York. This effort will provide an integrated production-scale development and demonstration project for solidifying approximately 600,000 gallons of high-level nuclear wastes. It is anticipated that approximately 300 canisters of vitrified high-level waste will be produced during the 18-month waste vitrification campaign. The project, located on a site previously used for reprocessing spent nuclear fuel for commercial purposes, is currently using existing facilities to the maximum extent possible.

Major activities to be performed as part of this project include: (1) decontamination required to prepare existing facilities and equipment to accommodate the solidification project; (2) removal of high-level waste from underground storage tanks; (3) development, design, construction, and operation of systems and support facilities for the solidification of the high-level waste; (4) acquisition of containers for the permanent disposal of the solidified waste; (5) storage and transportation of the solidified waste to an appropriate Federal geologic repository for permanent disposal; (6) decontamination and decommissioning of the waste tanks, and facilities, (7) decontamination and decommissioning of the hardware, and material used in carrying out the project; and (8) disposal of low-level and TRU wastes derived from project activities.

The high-level liquid waste is contained in underground storage tanks. The waste is comprised of a supernatant liquid above a sludge layer. The supernatant represents approximately 90 percent of the volume and 50 percent of the radioactivity of the stored high-level waste. This supernatant is currently being treated with expected completion of processing during FY 1991. The treatment process entails transferring the majority of radioactive constituents to an ion-exchange resin, that in turn, will be blended with the sludge and glass formers to produce canisters of vitrified high-level waste.

The low-level liquid waste stream resulting from this treatment system is being immobilized in cement and stored at the site in a shielded cell. As of the end of CY 1989 about 50 percent of the supernatant volume has been processed.

To facilitate the vitrification process, the sludge must be washed to remove certain chemical constituents. Installation and testing of the sludge washing equipment will begin during FY 1991 after liquid supernatant waste processing is completed. Construction of the facility to store the vitrified high-level waste canisters will also begin during FY 1991. Waste vitrification will be conducted in late FY 1993.

Hanford Waste Vitrification Project (HWVP)

The HWVP facility housing the vitrification process equipment and support services occupies an area of approximately 35 acres located southeast of B-Plant on the Hanford site. Hanford stores approximately 20 million gallons of

radioactive waste, a fraction of which will be vitrified. The waste will be pretreated in the B-Plant. Two waste streams will be produced during the B-Plant pretreatment step. One is the sludge resulting from concentrating the stored waste. The sludge will contain the bulk of the fission products and TRU elements. The other waste stream, much larger in volume, is the liquid from the concentrating process. Enough radioactivity will be removed from the large volume of liquid waste to permit disposal as low-level waste. The smaller volume of sludge will be sent to the HWVP for treatment. As with the product from the DWPF, the canisters of glass will be stored on site for eventual disposal at a Federal geologic repository.

Based on the current projection for funding, the total estimated cost for construction is $965 million. Construction is scheduled to start in the fourth quarter of FY 1991 and is scheduled to be completed in FY 1998. This would support the start of hot operation in FY 1999.

Idaho High Level Waste Tank Farm

Evaluation of the existing high-level tank and vault systems at the Idaho National Engineering Laboratory has confirmed that the present system cannot be modified to meet all current environmental regulations and DOE Orders. This project provides for construction of four new 500,000-gallon capacity high-level radioactive waste storage tanks, plus upgrade of auxiliary systems and transfer lines for existing underground storage tanks. The Idaho Chemical Processing Plant (ICPP) high-level radioactive waste tank farm currently consists of eleven 300,000-gallon capacity storage tanks. Five of the

existing tanks will be replaced by the four new tanks, which will be designed and built to meet RCRA regulations for hazardous waste tank systems, as well as applicable seismic and operational requirements.

Each tank will be constructed of stainless steel, and have a secondary containment meeting all applicable regulations and seismic requirements. The secondary containment will have a sump with a system for detecting collected liquids. The vault will provide required radiation shielding. A vault ventilation system using blowers and high-efficiency particulate air (HEPA) filters will be provided to enhance early leak detection capability.

Construction of the tanks will start in the fourth quarter of FY 1992 and be completed in the fourth quarter of FY 1998. The total estimated cost of the project is $270 million.

Idaho Chemical Processing Plant (ICPP)

Liquid radioactive wastes are produced from the reprocessing of spent fuel at the ICPP. A major portion of this recoverable irradiated fuel is from Navy propulsion reactors. These liquid wastes are stored temporarily in underground storage tanks prior to calcination in the New Waste Calcining Facility. This waste, which is highly radioactive, is also classified as hazardous waste under current RCRA regulations.

Compliance Agreements

We believe that it is both proper and in our best interest to negotiate formal compliance agreements with the regulatory authorities who have jurisdiction over portions of our waste management operations programs. We have executed agreements at several of our sites with the Federal EPA and the cognizant state authority. We have multi-party agreements with the host State and EPA Region at several of our sites and have signed, or are pursuing, similar agreements at Idaho, Savannah River, Oak Ridge, and several other sites. In most cases, these agreements lay out a schedule to allow DOE to operate in regulatory compliance on a workable schedule. We will continue to form such formal agreements at all sites that either generate or store such waste since to operate outside of an agreement may cause the regulator to serve a notice of noncompliance or refer to the Department of Justice for imposition of criminal penalties. The milestones specified in these agreements are a major factor in the growth of our budget request.

Many of the new construction projects requested in this budget are directly related to these agreements and our efforts to comply with the emerging regulations. For example, in Idaho, the existing high-level waste tanks cannot meet the RCRA regulations for hazardous waste tank systems, as well as the applicable seismic requirements. These will be replaced by new tanks which will meet all of the requirements. Construction of the Waste Receiving and Processing Facility at Hanford, which will provide treatment for stored and newly generated waste, is addressed in the Hanford Tri-Party Agreement. In general, strong emphasis will be placed on characterizing all DOE waste

streams so that the development and planning of treatment and disposal facilities will be adequate to meet regulatory-driven requirements.

Waste Minimization

It is the policy, as required in DOE 5400.1, to conduct DOE operations in a safe and environmentally sound manner, incorporating national environmental protection goals in the formulation and implementation of its programs. Accordingly, all DOE programs are required to institute a policy to reduce the total amount of waste that is generated by DOE activities, with emphasis on reducing the amounts of radioactive, hazardous, and mixed wastes that need to be treated and disposed. In FY 1989, guidance for implementing the DOE waste minimization program was developed in conjunction with the EPA. In May 1990, each DOE facility is required to have in place a waste minimization plan and program. These plans will be reviewed and revised as required to assure that the Department has an effective overall program that leads to significant reductions in the amount of wastes that must be managed in the future. In FY 1991, the DOE Waste Minimization Program will focus on assisting DOE facility managers in identifying ways to reduce the amount of waste generated by process improvements, materials substitutions, recycling and recovery of useful materials from potential waste streams, and treatment of wastes to reduce the toxicity and mobility of pollutants upon disposal.

National Low-Level Waste Program

The National Low-Level Waste Program provides assistance to States and compact

regions in developing new capacity for the disposal of low-level radioactive waste in accordance with Public Law 99-240, the Low-Level Radioactive Waste Policy Amendments Act of 1985. This legislation assigned individual States the responsibility for the disposal of low-level radioactive waste generated within their borders, with the exception of wastes generated as a result of certain Federal activities and low-level waste from licensed generators exceeding the limits established by the NRC for Class C low-level waste. The Federal Government is responsible for disposal of the excepted low-level waste. The formation of regional compacts among States to carry out their responsibilities is encouraged by the Act. To date, nine compact regions, incorporating 43 States, have been formed and consented to by the Congress.

Under this program, DOE administers an escrow account created by the Act, from which rebate payments are made to States that are in compliance with the Act's milestones. These funds, by law, can be used only for low-level waste management purposes. DOE determined each State's compliance status for the milestones that occurred on July 1, 1986, and January 1, 1988. The Department is currently determining States' compliance with the January 1, 1990, milestone and State and compact region eligibility for escrow account rebates totalling some $9 million.

During FY 1989, the National Low-Level Waste Program carried out the reporting and administrative activities required in the Act and focused on meeting the generic technical needs of the States and compact regions as they worked to select sites and develop new disposal facilities. In FY 1990, DOE continues to provide assistance to States and compact regions to support the selection

and development of new low-level disposal facilities. In October 1989, the Secretary submitted to the Congress the 1988 Annual Report on Low-Level Radioactive Waste Management Progress. This report concluded that States and compacts retain sufficient flexibility to negotiate mutually agreeable conditions for management and disposal of low-level waste without revision at this time of the fundamental framework embodied in the Federal law or imposition by the Federal Government of new terms and conditions. As States and compact regions proceed at different schedules toward the establishment of new disposal sites, the National Low-Level Waste Program expects that assistance will be directed more toward specific needs of individual States and compact regions. DOE is currently developing a strategy for acceptance and disposal of greater-than-class-C low-level waste from licensed generators in accordance with requirements of Public Law 99-240.

In FY 1991, the Department proposes to continue assistance to States and compacts and to provide for acceptance of limited amounts of greater-than-class-C low-level waste for storage and disposal. Development of a dedicated storage facility for general acceptance of Greater-Than-Class-C low-level waste will begin. Options for disposal of such waste will be assessed. The Department will also continue to carry out its administrative and reporting requirements, as required by law.

Waste Technology

The FY 1987 appropriations to the Department required continuation of the Department's research and development of tritium radioluminescent lighting

systems for utilization on remote airstrips. Support for this work continued to be mandated in FY 1988-90. In October 1989, this effort resulted in development of a solid-state tritium light source nearly four times brighter than conventional gas tubes. Further development of this breakthrough will continue in FY 1990, including efforts to transfer this technology to industry. Testing of radioluminescent lighting systems for remote airfields are also planned in cooperation with the Federal Aviation Administration. This effort will be phased out in FY 1991 since the goal for the program will have been met.

CORRECTIVE ACTIVITIES

The Corrective Activities Program is aimed at identifying what costs and activities are required to bring our facilities into full compliance with existing regulatory requirements. The goal of the Corrective Activities Program is to bring active and standby facilities at all DOE sites into compliance with all applicable air, water, and solid waste regulatory requirements, and DOE orders. The primary regulations governing these activities are the Clean Air Act, Clean Water Act, Resource Conservation and Recovery Act, Safe Drinking Water Act, Toxic Substances Control Act, and State and local ordinances. This program is composed of corrective activities at facilities operated by four major DOE base programs: Environmental Restoration and Waste Management, Defense Programs, Nuclear Energy, and Energy Research. Although accounted for in this budget activity, the efforts will be managed by their respective base program.

FY 1991 BUDGET REQUEST

Corrective Activities

Subactivity	(dollars in thousands) FY 1990	FY 1991
Environmental Restoration and Waste Management	$ 33,212	$ 58,427
Defense Programs	74,524	83,110
Nuclear Energy	995	4,112
Energy Research	16,023	22,949
Total	$124,754	$168,598

The FY 1991 budget request for Corrective Activities is $168,598,000. These activities are distributed among four base programs. Within the Environmental Restoration and Waste Management Program, the increase provides for environmental monitoring and analytical laboratory upgrades required to meet RCRA guidelines, and milestones established by the Tri-Party Agreement at Hanford. Within Defense Programs, the increase will support ES&H improvements at the national laboratories, replacement of PCB transformers at Los Alamos National Laboratory, construction of flood walls around storage areas at the Kansas City Plant, and completion of a potable water system at the Nevada Test Site.

The increase for the Energy Research Program is for conducting risk assessments at Lawrence Berkeley Laboratory and installation of low-level waste lines at our Oak Ridge National Laboratory. The Nuclear Energy Program increase is primarily for construction project activities at various facilities, such as the Energy Technology Engineering Center in California.

This activity provides for design,procurement, and installation of modifications needed to bring liquid effluent into compliance.

Savannah River Cooling Towers

Recently developed information indicates that the Savannah River Cooling Tower Project (89-D-142) will not be as costly as previously estimated. Accordingly, the FY 1991 request of $44,600,000 will be reduced to $28,000,000. Approximately, $21,000,000 of the FY 1990 appropriated amount will not be required in this year, and a reprogramming request is now in preparation to use those funds to meet other pressing compliance activities. The funds not required in FY 1991 will be considered a part of the $142 million reduction for slippages in the overall Environmental Restoration and Waste Management program.

ENVIRONMENTAL RESTORATION

The objectives of the Environmental Restoration Program are to perform remedial action and decontamination and decommissioning at contaminated DOE and legislatively authorized non-government facilities and sites; conduct assessments and characterization of DOE sites to determine if there is a potential for radioactive and hazardous waste releases; and to protect human health and the environment and return the facilities and sites to productive use, where appropriate. This program consolidates all remedial action and decontamination and decommissioning activities previously budgeted under the Office of Defense Programs; the Office of Nuclear Energy and the Office of

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Energy Research. The goal of the Environmental Restoration Program is the cleanup of these sites within 30 years. This goal supports the Department's policy of compliance with the letter and spirit of applicable Federal, State and local health, safety, and environmental statutes. Successful execution of this program is a key part of the Department's commitment to continue to protect public health and safety and to assure a safe and clean environment in connection with its activities.

The major Environmental Restoration activities are: (1) the Facilities and Sites activity which provides for the safe management and cleanup of contaminated sites throughout the country and includes characterization, remedial action, and closure activities at 22 major DOE installations in 15 States; (2) the Formerly Utilized Sites Remedial Action Project (FUSRAP) which currently includes 31 sites, 26 former Manhattan Engineering District or Atomic Energy Commission sites and 5 sites added by Congress; (3) the Uranium Mill Tailings Remedial Action Project (UMTRAP) which provides for cleanup of 24 inactive uranium mill tailings sites and 5000 associated vicinity properties; and (4) the Uranium Mill Tailings Groundwater Restoration Project which will restore, as necessary, the aquifers of 24 designated uranium mill tailings sites.

The requested funding for the Environmental Restoration Program is distributed among the program elements as indicated in the following table.

(dollars in thousands)

Subactivity	FY 1990 Appropriation	FY 1991 Request
Facilities and Sites	$ 548,567	$ 720,720
Formerly Utilized Sites Remedial Action Project . .	14,643	36,200
Uranium Mill Tailings Remedial Action Project . .	93,619	124,500
Uranium Mill Tailings Groundwater Restoration . .	0	1,000
TOTAL	$ 656,829	$882,420

FACILITIES AND SITES

The Facilities and Sites activity conducts remedial actions and decontamination and decommissioning projects to reduce and remove the potential risks to the environment and to human health and safety resulting from past Department activities. The program objective is to protect human health and the environment and return the facilities and sites to productive use, where appropriate.

The remedial action requirements are derived primarily from the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the Resource Conservation and Recovery Act of 1976, (RCRA) as amended. The program consists primarily of activities related to remediation of inactive waste disposal sites, uncontrolled release sites, and underground storage tanks. The scopes, schedules and cleanup standards for these activities are negotiated with the Environmental Protection Agency (EPA) and the States and are the subject of RCRA permits, Consent Orders and Compliance Agreements, and

CERCLA Federal Facility Agreements.

The Facilities and Sites activity FY 1991 budget request indicates significant percentage growth over FY 1990 in the funding proposed for cleanup activities, particularly those associated with CERCLA. The percentage spending for assessment and cleanup activities remains relatively constant over the FY 1989 through FY 1991 period. That is, about 60% and 40%, respectively. However, projections for the outyears, as shown in the Five-Year Plan indicate that these percentages are predicted to reverse by FY 1995, with cleanup activities expected to account for approximately 60% of expenditures.

There are several areas of intense effort in FY 1990 regarding completion of cleanups under RCRA corrective action requirements and acceleration of assessment activities under both RCRA and CERCLA. These activities, described below, are responses attributable to the Department's interaction with State and EPA regulators in negotiations that have put or are about to put into place Interagency Agreements or Agreements in Principle and are being negotiated on a voluntary basis with all the States that host Departmental facilities. The model for such agreements is the Agreement in Principle signed between the Department and the State of Colorado in June 1989. They provide for funding for the State and formalization of the Department's commitment for increased oversight and monitoring by the State of DOE's activities.

At the Rocky Flats Plant in Colorado, the Department agreed to accelerate remedial actions associated with the 881 Hillside, the 903 Pad Area and the

Solar Ponds. These interim remedial actions were to start by the end of FY 1989, or as soon as the regulatory process would allow. Action on all three areas is underway. An Environmental Assessment under the National Environmental Policy Act for the 881 Hillside ultraviolet/peroxide and ion exchange treatment system was performed in August 1989 and issued by the Department in January of this year. Construction of the system also started in January and operation is expected to commence by the end of this year. A remedial investigation for the 903 Pad Area was started in July 1989 and is scheduled for completion in FY 1993. Interim remedial action on the pad is currently being delayed through agreement with the regulatory agencies, while additional data is being collected. For the Solar Ponds, the Department is following the direction of the State for removal of materials and treatment of groundwater per the approved closure plan.

At the Feed Materials Production Center in Ohio, three interim remedial actions are currently being pursued. These address offsite groundwater contamination, perched groundwater under onsite buildings, and onsite uranium storage silos. All three of these actions currently involve characterization or preliminary engineering activities.

At the Oak Ridge Reservation in Tennessee, the Department has completed RCRA closures for eight former waste disposal facilities at the Y-12 Plant and interim closure of Solid Waste Storage Area 6 unlined waste storage trenches in FY 1989. Groundwater characterization is currently ongoing and will be used to help determine final closure requirements.

We are making significant progress achieving more specific agreements with Federal and State regulators regarding cleanup activities at our sites. As of the end of FY 1989, the Department had signed 43 interagency agreements, including Federal Facility Agreements, Federal Facility Compliance Agreements, Settlement Agreements, and Consent Orders and the aforementioned Agreement in Principle with Colorado. Notable among these agreements are the Tri-Party Agreement for the Hanford Site, the three party agreement under CERCLA for the Lawrence Livermore National Laboratory, and the Monticello Mill Site/Vicinity Properties three party agreement, also under CERCLA. Since the publication of the Five-Year Plan, the Department has executed a Notice of Intent to Sign a three party agreement with Colorado and EPA Region VIII for the Rocky Flats Plant. This agreement replaces and otherwise brings up to date, requirements for cleanup of the facility described in a three party agreement executed in July 1986. The Department has completed negotiations with State and Federal regulators for two more interagency agreements which will cover four of the Department's more notable facilities from a cleanup perspective. These four facilities are the Feed Materials Production Center in Fernald, Ohio and the three facilities at the Oak Ridge, Tennessee Reservation (Y-12 Plant, Oak Ridge National Laboratory, and Oak Ridge Gaseous Diffusion Plant). These agreements are in the final stages of review and are expected to be signed in the near future. The Department is also nearing completion of a Federal Facility Agreement with South Carolina and EPA Region IV for the Savannah River site. Finally, the Department has just initiated negotiations with the State of Idaho and EPA Region X for remediation of the Idaho National Engineering Laboratory in Idaho. This agreement will supersede the

requirements contained in the Consent Order Compliance Agreement for this facility signed in July 1987.

Much of the FY 1991 budget request for the Facilities and Sites activity is directly related to the enforceable requirements of existing and anticipated agreements. In November 1989, eight more Departmental installations were placed on the EPA Superfund's National Priorities List. Under the terms of CERCLA, interagency agreements will be required prior to proceeding with major cleanup activities on the sites associated with these installations.

A portion of the Facilities and Sites activity is the Decontamination and Decommissioning (D&D) Program which provides for the safe management and disposition of surplus facilities radioactively contaminated from DOE activities. The decontaminated facilities are to be released for use without radiological restrictions. The program currently includes over 250 projects at 33 sites in 17 States. Decommissioning has been completed at 21 projects in the program. Currently there are 26 active D&D projects underway and many facilities require surveillance and maintenance until decommissioning begins. Additional projects are expected to be included in the program as operating facilities become surplus. Decommissioning of the Shippingport Atomic Power Station which began in September 1985 was completed in early FY 1990. The project was completed ahead of schedule and under budget. This project successfully demonstrated decommissioning of the first commercial power plant.

The Weldon Spring Remedial Action Project in Missouri, designated a Major Systems Acquisition by DOE, has an approved FFA with EPA. The project

involves the remediation of a 231 acre Feed Materials Plant which supported Atomic Energy Commission efforts and was also used for ordinance activities by the Department of the Army. Work this year involves carrying out some interim actions which include construction of a waste water treatment facility, characterization activities, and continued preparation of a RI/FS.

The Department also has a FFA on the Monticello Remedial Action and Vicinity Properties Projects in Utah. A CERCLA Record of Decision has been issued for the Vicinity Properties Project and one is expected to be issued for the Remedial Action Project the third quarter of FY 1990. At this point, 65 of 112 authorized vicinity properties have been remediated. More properties are expected to be surveyed and authorized during the next two years. For the Remedial Action Project, a Final RI/FS is expected to be issued in mid-FY 1990.

The Battelle Columbus Laboratory Decommissioning Project in Ohio involves the decontamination and release of 15 buildings radioactively contaminated during work conducted by Battelle under contract to DOE. Most of the buildings are currently under surveillance and maintenance. Planning and characterization activities are currently underway. Approved interim actions have been taken at 2 buildings resulting in their independent certification and release for use without radiological restrictions. The majority of the work will begin at the end of FY 1990 after approval of the Environmental Assessment.

Other activities in FY 1991 will include cleanup efforts at the Argonne

National Laboratory in Illinois, the Santa Susana Field Laboratory in California, the Mound Laboratories in Ohio, the Oak Ridge National Laboratory in Tennessee, the Los Alamos National Laboratory in New Mexico, the Idaho National engineering Laboratory in Idaho, the Savannah River Site in South Carolina, the Hanford Site in Washington, and other DOE reservations and remote sites.

FORMERLY UTILIZED SITES REMEDIAL ACTION PROJECT

The Formerly Utilized Sites Remedial Action Project (FUSRAP) conducts remedial actions at former nuclear processing facilities which became radioactively contaminated as a result of Manhattan Engineer District or Atomic Energy Commission (MED/AEC) activities and have not been decontaminated sufficiently to meet current public health and safety guidelines. FUSRAP also includes certain contaminated sites specifically assigned to DOE by Congress for remedial action.

To remedy the situation at these contaminated sites, either the contaminated material will be stabilized in place, with restrictions placed on the use of the site, or the contamination will be removed and disposed of at another location. Remedial action is needed at 25 sites, formerly utilized by the MED/AEC, based on a review of the involvement of these predecessor agencies in previous site activities. Radiological monitoring is being provided for one other former MED/AEC site as part of this project. The review of sites involved in past activities of MED/AEC was completed in 1987. Additional

sites may be added to FUSRAP once followup site radiological surveys are completed.

Congress added four sites to the program when it enacted Public Law 98-50, the FY 1984 Energy and Water Development Appropriations Act, and directed that DOE initiate a decontamination research and development project at these sites as a priority action. With enactment of Public Law 98-360, the FY 1985 Energy and Water Development Appropriation Act, Congress directed DOE to reacquire the former St. Louis Airport Site in Missouri and use it to dispose of waste from cleanup of the nearby Latty Avenue site and vicinity properties. This brings the total number of sites in FUSRAP to 31.

The general approach to FUSRAP projects is to give priority to the cleanup for contaminated residential properties and to store the waste temporarily on each processing and storage site. At the Maywood, New Jersey site, field investigations of residential properties are continuing during FY 1990. Activities were initiated to prepare the Remedial Investigation/Feasibility Study - Environmental Impact Statement (RI/FS-EIS) for the Maywood site and these efforts will continue during FY 1991. Negotiations with the Environmental Protection Agency (EPA) on a Federal Facility Agreement (FFA) are continuing and the FFA is expected to be signed during FY 1990. Remedial Investigations of the Stepan property will be performed in FY 1991 and characterization of Lodi vicinity properties will be completed. Ongoing negotiations with the EPA will result in a signed FFA in FY 1990 for the Wayne, New Jersey site. Efforts have been initiated on preparation of the necessary RI/FS-EIS documents and these activities will continue in FY 1991.

All site remedial investigations at Wayne will be completed by the end of FY 1990.

At the Colonie, New York site, efforts are continuing on preparation of the RI/FS-Environmental Assessment (EA) during FY 1990 and will be finalized in FY 1991. The Record of Decision will then be issued to determine the disposition of wastes at this site. Removal of asbestos and equipment from the Colonie, New York site building will be initiated in FY 1991 and building demolition will commence. Planning documents and characterization reports for the Ashland #1, Ashland #2, and Linde, New York sites will be issued in FY 1990. The preparation of RI/FS-EIS documents will be initiated for the New York disposal Site. Remedial investigations of vicinity properties in Linde, New York will be initiated in FY 1991.

Cleanup of vicinity properties around the St. Louis Airport Site (SLAPS) in Missouri will continue in FY 1990 and FY 1991. Negotiations are continuing to reach an agreement with the EPA and the State of Missouri on SLAPS and on the nearby Hazelwood, Missouri site. Preparation of the RI/FS-EIS documents for both sites were initiated in FY 1990 and will continue in FY 1991.

URANIUM MILL TAILINGS REMEDIAL ACTION PROJECT

Public Law 95-604, the Uranium Mill Tailings Radiation Control Act of 1978, assigned to DOE the responsibility for conducting remedial action at 24 former uranium ore processing sites and several thousand contaminated vicinity properties. The Act provided authority for remedial action by the Department

for a period of 7 years following promulgation of standards by the environmental Protection Agency (EPA), which occurred in March 1983. However, it became apparent several years ago that the work could not be completed within the 7-year authorization period because of the scope and nature of the work required to comply with the EPA standards, the large number of sites and vicinity properties, and the impracticality of seeking or obtaining the large annual appropriations required to complete the work within the 7-year period. Public Law 100-616, the Uranium Mill Tailings Remedial Action Amendments Act of 1988, extended the Department's authority to perform remedial actions through the end of FY 1994. Completion of all remedial actions by that date will require appropriations in excess of $120 million per year through FY 1993. The department is assessing the completion date. Due to project changes it appears the completion date of 1994 will slip by at least one year and the total estimated cost could increase by $50 to $70 million.

The program strategy is to focus near-term activities on the higher priority sites and on vicinity properties. Remedial actions are being conducted in accordance with cooperative agreements negotiated with the affected States and Indian tribes. Federal funds cover 90 percent of the remedial action cost (100 percent for the sites on Indian lands), and the States provide funding for the remaining 10 percent. The type of remedial action for the processing sites is to stabilize the mill tailings in place, where possible, or to remove them to a new disposal site. In either case, the final disposal sites will be Federally owned and maintained under NRC license. Engineering plans and environmental documents are prepared for each site cleanup and disposal operation. Concurrence by the NRC and the affected State or Indian tribe is

required for the remedial action plan at each site. The project also involves the cleanup for an estimated 5,000 contaminated vicinity properties, 4,000 of which are in the Grand Junction, Colorado, area. By the end of FY 1989, cleanup activities were completed or initiated at over 65 percent of these properties.

On January 5, 1983, EPA issued final standards for the disposal and cleanup of the inactive mill tailings sites under the Uranium Mill Tailings remedial Action Project (UMTRAP). These standards were challenged in 1985 before the Tenth Circuit Court of Appeals. The court dismissed all challenges except one--it set aside the groundwater provisions and recommended that EPA issue standards of general applicability. On September 24, 1987, EPA issued its proposed rule and the comment period closed January 29, 1988.

In its comments to EPA on the proposed rule, DOE supported the basic intent of the proposed standards to protect human health and the environment. However, concern was expressed that it would cost the Federal Government over $1 billion to restore groundwater contaminated by the inactive mill tailings without a commensurate quantification by the EPA of the health benefits gained by the expenditure of this large amount of money. We believe that the cost of implementing the proposed groundwater restoration program is far too great for the modest potential health effects projected. We anticipate that the EPA will issue its final rule in the Spring of 1990. The Department has proposed in its FY 1991 budget request to Congress that formal planning of groundwater restoration at UMTRAP sites begin in FY 1991. This activity, to be budgeted separately from UMTRAP, will be discussed in the next section.

During FY 1989, work was underway at 13 of the 24 processing sites. The work at Salt Lake City, Utah was completed, as well as cleanup of vicinity properties at Edgemont, South Dakota. Processing site remedial action was begun and completed at Spook, Wyoming. Onsite work continued at Ambrosia Lake, New Mexico; Durango, Colorado; Lakeview, Oregon; Mexican Hat, Utah; the two sites at Rifle, Colorado; Riverton, Wyoming; and Tuba City, Arizona. Processing site remedial action was begun at Green River, Utah; Grand Junction, Colorado; and Monument Valley, Arizona. Remedial action at approximately 740 vicinity properties was also completed or initiated.

During FY 1990, remedial action will be underway at nine processing sites, and an estimated 700 vicinity properties will be completed or initiated. During the first quarter of FY 1990, remedial actions were completed at Green River, Utah; Riverton, Wyoming; and Lakeview, Oregon, bringing the total of completed sites to seven. Remedial actions at Tuba City, Arizona are scheduled to be completed during FY 1990. Remedial actions at Falls City, Texas are scheduled to begin late in FY 1990. Site remedial action will continue at Grand Junction and Durango, Colorado. Remedial action work at Mexican Hat, Utah and Monument Valley, Arizona will be suspended temporarily near the mid-point of FY 1990 due to budget constraints. Surveillance and maintenance efforts will be continued at completed sites.

During FY 1991, remedial action will be underway at nine processing sites and an estimated 490 vicinity properties will be completed or initiated. Remedial actions will be resumed at the two Rifle, Colorado sites; at Mexican Hat,

Utah; Monument Valley, Arizona; and Ambrosia Lake, New Mexico. Remedial actions will be completed at Durango, Colorado. Remedial actions will continue at Falls City, Texas and Grand Junction, Colorado. Remedial actions will be initiated at Gunnison, Colorado. Surveillance and maintenance efforts will be continued at completed sites.

During FY 1991, remedial action will be underway at nine processing sites and an estimated 490 vicinity properties will be completed or initiated. Remedial actions will be resumed at the two Rifle, Colorado sites; at Mexican Hat, Utah; Monument Valley, Arizona; and Ambrosia Lake, New Mexico. Remedial actions will be completed at Durango, Colorado. Remedial actions will be initiated at Gunnison, Colorado. Surveillance and maintenance efforts will be continued at completed sites.

URANIUM MILL TAILINGS GROUNDWATER RESTORATION PROJECT

The Uranium Mill Tailings Groundwater Restoration Project will restore, as necessary, the aquifers at 24 designated uranium mill tailings sites to ensure compliance with EPA groundwater protection standards. FY 1991 is the first year funding is being requested for this project. Pre-project planning costs in FY 1988 and FY 1989 were funded by the Uranium Mill Tailings Remedial Action Project (UMTRAP).

This project will carry out additional characterization and restoration efforts not covered by UMTRAP as described previously. It is being budgeted as a separate category since the current UMTRAP activity has a well defined

scope, schedule, and approved Total Estimated Cost (TEC). This project, like UMTRAP, is authorized by Public Law 95-604, the Uranium Mill Tailings Radiation Control Act of 1978. Public Law 100-616, the Uranium Mill Tailings Remedial Action Amendments Act of 1988, extended the period of authorization for conducting remedial action for UMTRAP until the end of FY 1994, and authorized an unlimited time period for conducting groundwater restoration activities. DOE pays 90 percent of the remedial action cost and the States pay the remaining 10 percent. For sites on Indian Lands DOE pays 100 percent of the cleanup costs. Activities in FY 1991 will include initiation of site characterization efforts at the Naturita, Colorado site and design development efforts at the Riverton, Wyoming and Gunnison, Colorado sites.

FUTURE DIRECTION

The Environmental Restoration Program has made significant progress over the past year in identifying and prioritizing its needs for the next 5 years. In addition to meeting the challenges of existing and anticipated regulatory requirements, the Department is looking to the future by undertaking actions to facilitate the smooth and efficient operation of the Environmental Restoration and Waste Management programs. These include development of a Programmatic Environmental Impact Statement for all activities addressed in the Five-Year Plan, development of a centralized database to facilitate program management and information exchange both within and outside the Department and innovative contracting mechanisms for remediation work at our field installations. While the Programmatic Environmental Impact Statement is not expected to be completed until FY 1993, planning and public scoping is

expected to be complete prior to the end of FY 1990. The database efforts and streamlined contracting procedures are expected to be in place to support program activities by the end of FY 1991.

We recognize that many challenges face us, both from the sheer magnitude of the cleanup problem and from the need for technological breakthroughs to accomplish cleanup in a timely, cost-effective, and environmentally compliant manner. The Department needs to continue its dialogue with the Federal and State regulators and the public, to be flexible in its response to new findings and regulatory requirements, and to be innovative in its approach to solving some of the most complex and difficult cleanup problems ever faced by this nation.

TECHNOLOGY DEVELOPMENT

The primary mission of the Technology Development program is to establish and maintain an aggressive national program for applied research, development, demonstration, testing, and evaluation (RDDT&E). The principle objective of the program is to resolve major technical issues and rapidly advance beyond current technologies for environmental restoration and waste management operations. The program is directed to support activities under the Office of Environmental Restoration and Waste Management.

This program mission supports the Department of Energy's (DOE) 30-year compliance and cleanup goal by: (1) establishing the management process for funding technologies at their various stages of development and deployment for

better, faster, and more cost-effective interim and permanent solutions to environmental problems; (2) conducting an innovative, aggressive technology development program for waste management, waste minimization, waste treatment, storage, and disposal; (3) developing more effective remediation technology for restoration of contaminated sites and facilities; (4) developing technologies to reduce occupational and public exposure; (5) establishing a coordinated education program involving universities, DOE national laboratories, and industry to train the people needed to address DOE's Environmental Restoration and Waste Management problems; and (6) promote technology transfer and outreach among the Department, private sector, and other agencies.

The Technology Development program provides the innovative technology, its progressive development, and its demonstration to make available new technology for environmental cleanup and restoration, decontamination and decommissioning, and waste management including minimization and disposal.

During fiscal year 1990, the Applied Research, Development, Demonstration, Testing and Evaluation Plan was prepared by DOE for submission to Congress, the States, and a wide distribution of interested parties to describe the needs for technologies, the current state of technologies and to plan activities to fulfill DOE's objectives to reduce risk to human health and the environment, decrease cost, and achieve a 30-year restoration goal. This plan will appear in the annual updates of the Environmental Restoration and Waste Management Five-Year Plan.

Technology Development was organized as a separate supporting effort in FY 1990 and provided a significant increase in funds to accelerate needed developments on high-priority problems, i.e., those requiring better, more permanent solutions. Emphasis is placed on improved or new technology for characterization of sites to determine the magnitude and extent of contamination spread and its physical and chemical nature. Industrial, university and DOE laboratory methods are being studied for the most capable and effective restoration and treatment techniques which can be applied to a broad range of DOE site problems. Establishing a separate technology development program provides the focus of scientific talent to effectively screen available and evolving technologies and provide demonstrated and proven methods for use.

At the heart of RDDT&E implementation is our goal to utilize a broad base of expertise in Federal and State agencies, the national laboratories, industry, and universities. Our challenge is to focus the creativity in these institutions on creative, problem-solving R&D and technology development. Consequently, we are providing incentives that will encourage the submittal of cooperative, multi-institution proposals.

We envision a "developmental cycle" in which applied R&D would be carried out primarily at the National Laboratories and universities. These efforts would be supported by industry in the development of innovative technology, for example, for ground water remediation and in situ stabilization of wastes. When a technology enters the demonstration phase, the laboratories would be teamed with industrial partners to provide cleanup demonstrations at DOE and

private sector sites. In the final phase of the cycle, technology would be transferred to industry for wide-scale application at sites requiring remediation.

Applied R&D activities have been initiated, for example, to pursue alternative technologies to minimize the quantity and/or toxicity of waste streams, to evaluate the cost effectiveness of separating slightly contaminated waste for alternate, less costly, disposal, to test supercritical water oxidation processes for waste treatment and to develop design concepts for fiberoptic monitoring of organic hazardous wastes.

Demonstration activities are underway for treatment and disposal of reactive materials, waste acid detoxification and remediation, in situ vitrification, and plasma arc processing to destroy hazardous organic materials. An integrated demonstration test bed is being established at the Savannah River site where DOE laboratories, universities and industry can demonstrate technologies for removal of organic chemicals from soil and groundwater.

Many observers have noted the shortage of professionals in the environmental restoration and waste management areas. The shortage is even more acute in the RDDT&E disciplines that support cleanup authorities. For this reason, we will vigorously support education programs to meet present and future personnel needs. We are taking the long view that we want to assure that a knowledgeable talent pool will exist to complete DOE's cleanup program in 30 years. Two major university consortia have already been established to support our office - one in New Mexico and one in South Carolina.

In order to take maximum advantage of similar R&D activities being conducted at other federal agencies, we have established partnerships with the U. S. Environmental Protection Agency (USEPA), the Department of Defense, and the National Institute of Standards and Technology. Additional collaboration is planned with the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, and the Department of Health and Human Services.

As an example of our interagency collaboration, we have initiated our first cooperative technology demonstration project with the EPA. The project, a plasma arc furnace, is to demonstrate the thermal destruction and immobilization of hazardous wastes and contaminated soils. This plasma technology offers cost savings in hazardous and mixed waste treatment and immobilization of heavy metals and radionuclides.

FY 1991 BUDGET REQUEST

Technology Development

(Dollars in Thousands)

Subactivity	FY 1990	FY 1991
Applied Research and Development	$ 39,840	$ 39,840
Demonstration, Testing and Evaluation	99,609	94,409
Education	20,685	27,731
Capital Equipment	3,347	16,820
All Other	20,000	27,200
Total	$183,481	$206,000

Our request for Technology Development for FY 1991 is $206.0 million, a 12 percent increase over FY 1990. An increase of $7.0 is requested for educational development to expand on initiatives begun in FY 1990. Two additional university partnerships will be established. Additional scholarships and fellowships in environmental restoration and waste management disciplines will be supported. Workshops on FY 1990 outreach activities will be conducted, and program expansion developed based on lessons learned. Applied R&D and demonstration, testing and evaluation activities begun in FY 1990 will be evaluated for continuation. Promising new initiatives will replace efforts that have less potential for impacting key environmental restoration and waste management problems.

The capital equipment request reflects a significant increase, $13.5 million, to establish an equipment budget for technology development. RDDT&E equipment is required in such areas as pilot-scale robotic waste handling, in situ vitrification, remote exhumation of buried mixed waste, analysis and monitoring.

PROGRAM DIRECTION

In November 1989, the Office of Environmental Restoration and Waste Management was established to manage and direct Five-Year Plan activities. A primary reason for consolidating environmental management functions under one organization is to provide centralized management and planning for more focused control and validation of costs, schedules and prioritization of projects. The FY1991 budget request provides for a staffing level of 116 at

Headquarters and an additional 85 staff located at four DOE Operations Offices. Program Direction is to fund employee salaries, benefits, overtime, contract support, travel, printing and reproduction services.

FUNDING SUMMARY

(Dollars in Thousands)

Subactivity	FY 1990	FY 1991
Headquarters	$ 4,980	$ 19,939
Operations Offices	570	4,167
TOTAL	$ 5,550	$ 24,106

The budget request provides for only the essential staff levels needed to continue to build an organization responsible for aggressive implementation of the activities described in the Five-Year Plan.

CONCLUSION

DOE is making progress in developing a systematic, focused course of action to address its environmental problems. On-going activities and recent initiatives include implementation of the Secretary's 10-point environmental protection plan, the continued negotiation of federal facility agreements, and implementation of an overall framework for conducting specific environmental-related activities, the Environmental Restoration and Waste Management Five-Year Plan.

The Plan reflects the goal to clean up and restore the environment at its

nuclear sites within 30 years. While progress may appear slow to some, we are convinced that credibility is going to be the key. This credibility will come through implementation of the Five-Year Plan. One significant element of these related activities is that DOE has sought the assistance of outside groups previously considered as adversarial to the operation of DOE facilities in preparing both its Five-Year Plan and site-specific work plans by each Operations Office to implement the Five-Year Plan. The utilization of these outside groups is a hallmark of the Secretary's tenure at DOE. It represents a significant change in the way the Department conducts its business. Achieving progress in implementing these measures will go a long way toward gaining public acceptance of our ability to manage and operate DOE-owned facilities safely and in an environmentally-sound manner. Only through this difficult process will DOE, as an institution, assume its proper role as a good neighbor and protector of the environment. We believe that DOE can and will be able to achieve its important national security objectives while complying with this nation's environmental laws.

Mr. Chairman, this completes my statement. I would be pleased to respond to your questions at this time.

THURSDAY, MARCH 15, 1990.

DEPARTMENTAL ADMINISTRATION

WITNESSES

JIM E. TARRO, ACTING DIRECTOR, ADMINISTRATION AND HUMAN RESOURCE MANAGEMENT

JACQUELINE KNOX BROWN, ASSISTANT SECRETARY, CONGRESSIONAL AND INTERGOVERNMENTAL AFFAIRS

JOHN C. LAYTON, INSPECTOR GENERAL

MELVA GIBSON WRAY, DIRECTOR, OFFICE OF MINORITY AND ECONOMIC IMPACT

STEPHEN A. WAKEFIELD, GENERAL COUNSEL

JOHN J. EASTON, JR., ASSISTANT SECRETARY, INTERNATIONAL AFFAIRS AND ENERGY EMERGENCIES

LINDA G. STUNTZ, DEPUTY UNDER SECRETARY, POLICY, PLANNING AND ANALYSIS

MARY JOY JAMESON, ACTING DIRECTOR OF PUBLIC AFFAIRS

Mr. MYERS. The Chairman is temporarily delayed in another committee trying to establish a quorum.

We have a great many witnesses today. We welcome the Department of Energy Administrative Personnel, the working people in that Department. At this time we will hear from Director Tarro.

Mr. TARRO. Thank you, Mr. Chairman and members of the subcommittee. I appreciate the opportunity. Frankly, I am honored to appear before you today to discuss the Fiscal Year 1991 Congressional Budget Request for the Departmental Administration appropriation.

In addition, I am going to discuss the In-house Energy Management, the Technical Information Management, and the Strategic Facilities Utilization programs that are requested in Energy, Supply, Research, and the Development appropriation.

Testimony will be presented by principal spokespersons for the other major areas within Departmental Administration. With me today are: Jacqueline Knox Brown, Assistant Secretary for Congressional and Intergovernmental Affairs; John Layton, our Inspector General; Melva Wray, who is Director of Minority Economic Impact; Stephen Wakefield, who is our General Counsel; John Easton, Jr. who is Assistant Secretary for International Affairs and Energy Emergencies; Linda Stuntz, Deputy Under Secretary for Policy, Planning and Analysis; and M.J. Jameson, who is Acting Director of Public Affairs.

Mr. Chairman, with your permission I'd like to present our verbal summary of the Fiscal Year 1991 Budget Request and submit my prepared statement for the record.

Before I present an overview of the Departmental Administration Fiscal Year 1991 budget, I'd first like to take this opportunity just to highlight a few of our accomplishments.

We have been active in providing coordination and staff support to the Office of the Secretary for implementation of his high-priority initiatives to strengthen Departmental line management authority and accountability for environment, safety, and health aspects of program execution.

The Office of Procurement initiated a proposed rule to revise the Department's policy on indemnification. We published this in the Federal Register, dated January 26, 1990.

Also, we have modified the award fee criteria in contracts for operation of the Defense production facilities to increase emphasis on environment, safety, and health programs.

A computerized prototype management system was designed, developed and implemented for capturing and using data related to nuclear facility incidents. This system contains data on Savannah River incidents, and expansion to other reactor sites is anticipated.

The Office of Administration has established a Computer Incident Advisory Capability. This is to assist Department sites in preventing, as well as detecting, unauthorized entry into our secured or sensitive data bases and facilities.

The Department served as a pilot agency to develop a mainframe-to-mainframe link with Treasury's financial management system, for the purpose of electronically transmitting our year-end financial statements to the Department.

The Office of the Controller implemented a system called DISCAS, the Departmental Integrated Standardized Core Accounting System at the Federal Energy Regulatory Commission, and completed the core compliance review to further standardize DOE's accounting system.

A program plan and implementation schedule was developed for the drug-free Federal workplace testing and education program.

And the Office of Administration implemented the Department's Integrated Security System for nationwide operational use. This system allows centralized tracking of the status of all DOE and contractor clearances, and visits for classified purposes by U.S. citizens at each of our DOE facilities.

With that, I would like to present an overview of the budget.

The Fiscal Year 1991 Budget Request for Departmental Administration is $424.2 million. This is composed of $308.1 million for administrative operations and $116.1 million for the Cost of Work for Others programs.

In addition, the Cost of Work for Others program, under DOE's full cost-recovery concept, is expected to generate $124 million in revenues. An additional $59.4 million in other revenues is estimated to be generated from the sale of incidental by-products. There is also $16.4 million in unobligated balances from the Fiscal Year 1989 budget that is being deferred into the Fiscal Year 1991 budget to reduce the budget authority requirement in the Departmental Administration account.

Under the Energy Supply, Research, and Development appropriation the total funding request for the respective activities is $38.5 million. This includes $20.5 million for the In-house Energy

Management program, $15 million for the Technical Information Management program, and $3 million for the Strategic Facilities Utilization program.

Mr. Chairman, this concludes my presentation. Jacqueline Knox Brown is prepared to speak to the activities of the Office of Congressional and Intergovernmental Affairs.

[The prepared statement of Mr. Tarro appears at the end of the hearing record.]

Mr. BEVILL [assuming chair]. The Chair recognizes you, Mrs. Brown.

CONGRESSIONAL AND INTERGOVERNMENTAL AFFAIRS

Mrs. BROWN. Good morning, Mr. Chairman and Congressman Myers. I appreciate this opportunity to appear before you this morning to discuss the Fiscal Year 1991 budget request for the Office of Congressional and Intergovernmental Affairs.

I will very briefly summarize my written testimony.

My office performs a broad range of liaison and outreach responsibilities. Our primary responsibility is to provide for the overall coordination and outreach for the Department's programs by serving as the principal point of contact with the Congress and other levels of government, as well as the private sector.

In Fiscal Year 1991 we plan to enhance the activities of our office, and thus we have instituted a number of organizational modifications within our program.

We are working very, very hard to improve the process for providing information to the Congress. That remains our number one priority for the Secretary, as well as our office—to make sure that information comes to the Congress in a timely manner; including testimony and follow-up answers to questions from hearings, transcripts from hearings, and just general announcements about the Department's activities. That information flows through my office, and we are working very hard to improve that process.

The budget request for the Office of Congressional and Intergovernmental Affairs for Fiscal Year 1991 is $3.8 million. I believe that funding level allows for an adequate staff to meet the office's wide range of responsibilities. We have 69 full-time equivalents allocated to our activities.

Last year we had over 140 hearings before the Congress. We had over 200 witnesses that had to prepare testimony to present to the various committees having jurisdiction over our programs. That activity involves my office to a great deal. We are very much responsible for making sure that testimonies for those hearings are prepared and that they are delivered and that people who are testifying are prepared to come do that. So we will continue to do that. We expect to have about the same number of hearings this year. We are going to be very busy with hearings before the Congress this year.

I'd like to summarize for a moment some of the issues that we plan to be involved with this Fiscal Year. My office is very much involved with the liaison activities and the outreach activities before the Congress as we deal with clean air, proposals on global

climate change, initiatives in conservation and renewable energy, and other issues.

We are also improving our outreach activities. We are trying to provide for increased access for Congressional staff people with our program officials within the Department. We are conducting briefings on a more frequent basis to make sure that staff and Members are informed about our major announcements and our policy changes within the Department.

We have a greatly increased our liaison efforts with State and local governments. We are monitoring State and local government activities much more and trying to integrate what is happening out in the States with what is happening in the Congress, so that we are more responsive to what is happening throughout the country as we approach some of these issues.

As I said before, one of the things we have done in my shop is to reorganize the operations by making sure we are utilizing the 69 staff people that we have as effectively as possible. I think what we have done is in line with Secretary Watkins' approach to a greater level of accountability with line management of the Department. Our Office of Congressional and Intergovernmental Affairs certainly is in line with that.

I believe the efforts that we have undertaken will enhance the communications between the Congress and the State and local governments.

In closing, I would just like to say I believe that my staff works very well with the members of this committee and other Members of Congress and we want to continue that relationship. On behalf of the Department we look forward to a productive and a continuing working relationship.

Thank you very much.

Mr. BEVILL. You are going to be spending a lot of time on the Clean Air bill. I hope you can help with it.

Mrs. BROWN. We'll try very hard. Thank you.

Mr. BEVILL. All right.

[The prepared statement of Mrs. Brown appears at the end of the hearing record.]

Mr. BEVILL. The Chair recognizes Mr. Layton.

INSPECTOR GENERAL

Mr. LAYTON. Mr. Chairman, I am pleased to address this subcommittee this morning. I would like to submit my full testimony for the record and summarize it.

Mr. BEVILL. Yes.

I would ask each of you to just summarize your statements. Your full prepared statements will be made a part of the record.

Mr. LAYTON. Thank you, sir.

Our Fiscal Year 1991 budget request is for $28.4 million. This will support 256 FTEs, which is an increase of 16 over Fiscal Year 1990.

To augment our auditing capability, our budget request includes $5.5 million to be used for contract audit services. This represents a decrease of $300,000 from 1990.

The additional FTEs will enable us to expand our reviews of those critical areas associated with environment, safety and health, safeguards and security, weapons programs, procurement, and other management issues that impact on economy, efficiency, and integrity of operations.

Our accomplishments during the past year have been significant. I'll summarize just a few of those.

We issued 348 audit reports, with a dollar impact of over $600 million—an increase of 75 percent over the previous year.

We increased investigative monetary collections from $150,000 in Fiscal Year 1986 to over $1.6 million for the first four months of this year.

We issued 12 inspection reports concerning management operating contractor accountability, environment, safety and health, and national defense needs.

We also established an environmental hotline. That has proven to be useful.

We will continue to pursue the major initiatives outlined in the Secretary's Ten-Point Plan to move the Department more aggressively toward full accountability in the areas of environment, safety and health. We will also focus more of our efforts on those high-risk areas outlined by this Administration. These include: reviewing the Department's management of its management and operating contractors, major systems acquisitions, and the Cost of Work for Others programs; reviewing and investigating environment, safety and health issues, conducting additional investigations associated with procurement fraud and integrity of the Department and in contractor employees, and in performing inspections and identifying ways to enhance the efficiency and effectiveness of DOE programs, and to ensure that Federal funds are spent productively and for the purposes for which they were appropriated.

That concludes my opening statement. I would be pleased to answer any questions.

Mr. BEVILL. All right.

[The prepared statement of Mr. Layton appears at the end of the hearing record.]

Mr. BEVILL. The Chair recognizes Ms. Wray.

OFFICE OF MINORITY AND ECONOMIC IMPACT

Ms. WRAY. Good morning, Mr. Chairman, Mrs. Boggs, and Mr. Myers. I appreciate this opportunity to appear before you today to discuss the Fiscal Year 1991 Congressional Budget Request for the Office of Minority and Economic Impact.

I have submitted my prepared statement for the record, and I would like to briefly summarize some of the significant portions of my statement.

The major programs in the Office of Minority and Economic Impact focus on socio-economic research and analysis, management and technical assistance, and financial assistance programs.

The goals and the objectives of these programs are to assist in determining specific energy policies, programs, legislation, and regulations which are needed to significantly enhance the economic

conditions of minorities in the dynamic energy technology environment.

The Office of Minority and Economic Impact is currently restructuring its program strategies to not only accomplish its legislative mandate in a more efficient and cost-effective manner, but to also contribute to the initiatives and the overall goals of the Department. The office is already involved in a number of departmental initiatives.

Some of the new program strategies will enhance the infrastructure in minority educational institutions and the effectiveness of management, technical, and financial assistance available to assist minorities and the minority communities.

In addition to the socio-economic research program strategies, that will enhance the Department's overall energy assessment capabilities to assist the energy industry with some of their determinations and contributions to the establishment of consensus of energy issues.

During my brief tenure of the four months that I have been in office, the programs have made remarkable advances in reestablishing some of the very important linkages within the Department, with the national energy laboratories, with other Federal agencies, universities, and energy industry organizations.

The educational programs have assisted minority education communities to become involved with research and development efforts in the Department.

I would like to assure you that the Office of Minority Economic Impact will continue to enhance its focused program strategies to increase the level of participation of minorities in the energy technology activities and other economic opportunities in the Department and in the energy industry.

It has been a great privilege for me to appear before you today, and I look forward to my continued service to the Department of Energy, as well as the Administration.

Thank you.

Mr. BEVILL. Thank you very much.

[The prepared statement of Ms. Wray appears at the end of the hearing record.]

GENERAL COUNSEL

Mr. BEVILL. Mr. Wakefield, the Chair recognizes you.

Mr. WAKEFIELD. Thank you. Mr. Chairman and members of the committee, I am pleased to appear before you today to discuss the Fiscal Year 1991 budget request for the Office of General Counsel.

The General Counsel is the principal legal advisor to the Secretary and provides legal services for the Secretary and the Department which include legal counselling, legislative drafting, development of regulations, and the conduct of litigation. In addition, the office administers the Department's standards of conduct and patent programs. As of today the Office of General Counsel has 161 individuals on board, of which 114 are attorneys.

During the past year our attorneys, in conjunction with Department of Justice attorneys, have represented the government in a

wide array of significant lawsuits which involve, among other matters, environmental, contractual, and waste storage issues.

In the area of regulatory development, the Office of General Counsel has played a significant role in several major rulemaking proceedings.

Although the office's litigation and rulemaking efforts are certainly the most visible means by which we provide legal support to the Department, other legal services may have an equal impact over the long term. For example, the office is actively engaged in the development and consideration of legislative issues that would affect the Department.

Other services that the office provides include: support for the clean coal technology program and other major procurement matters, international arrangements such as the U.S.-Canada Free Trade agreement and alternate financing for the Strategic Petroleum Reserve, and the considerable, and still-growing effort to assure that the Department's activities comply with the letter and the spirit of laws and regulations designed to protect the environment and public and worker health and safety.

The Fiscal Year 1991 budget request for the Office of General Counsel is $10,959,000. This request would provide $9.6 million for 159 FTEs and $1.3 million for support funding, which is principally travel and library services for the office. With this budget I believe the office can continue to provide the same professionalism in rendering legal services which we have been able to furnish to the Department since the formation of the Department.

Thank you, Mr. Chairman.

Mr. BEVILL. Thank you, Mr. Wakefield.

[The prepared statement of Mr. Wakefield appears at the end of the hearing record.]

Mr. BEVILL. The Chair recognizes Mr. Easton.

INTERNATIONAL AFFAIRS

Mr. EASTON. Thank you, Mr. Chairman and members of the subcommittee. I am pleased to be here to describe our Fiscal Year 1991 budget request.

My testimony this morning will cover two of the three offices that make up the Office of International Affairs and Energy Emergencies—my Office of International Affairs and the Office of Policy and Management, which is my administrative support office.

Our primary responsibilities in the International Affairs Office are to develop and to implement international energy policy that is consistent with both our domestic energy policy and our U.S. foreign policy. In addition, our office provides independent advice to the Secretary of Energy on international energy-related matters.

We do this through a number of different responsibilities and commitments: we monitor the world energy markets; analyze and assess trade, price, and supply trends of energy; we develop departmental positions for our international negotiations; we develop international nuclear policies, including nonproliferation policies; we develop and administer a program of technical exchanges and collaborative research and development with foreign governments;

and we represent the United States in international energy organizations.

Our budget request for Fiscal Year 1991 for the Office of International Affairs is $5,059,000, and that covers 51 FTEs. This budget request includes $1.4 million for international policy studies, for which $300,000 of that is for continuation of the RERTR program—the Reduced Enrichment for Research and Test Reactors. That had been previously funded in the Nuclear Energy Office's budget, and now it has been returned to our budget.

Our basic policy studies request is roughly the same as it was last year.

During the past year we have been active in a variety of ways, both in international energy programs and in new activities. I have included some of these in my written statement, which has already been furnished, listing those.

The Office of Policy and Management, which is the administrative part of our office, the glue that holds us together, has a budget request of $1 million, which is about $500,000 down from Fiscal Year 1990. The reason for that decrease of $571,000 is that we are reducing the number of FTEs from 18 down to 12.

As I said, that office provides the administrative support functions for the total organization of both international affairs and energy emergencies.

Mr. Chairman, this concludes my presentation. I'll be happy to answer any questions.

Mr. BEVILL. Very good.

[The statement of Mr. Easton appears at the end of the hearing record.]

POLICY, PLANNING AND ANALYSIS

Mr. BEVILL. Ms. Stuntz?

Ms. STUNTZ. Thank you, Mr. Chairman, Congressman Myers, and Congressman Boggs. It is a pleasure to be before you today to describe the Fiscal Year 1991 budget request for the Office of Policy, Planning and Analysis and to very briefly summarize the activities of that office.

Our request for Fiscal Year 1991 is $9.3 million, a modest increase over Fiscal Year 1990. That will support 75 FTEs. The reason there is a modest increase is because the role and responsibilities of the Office of Policy have been significantly expanded under the direction of Secretary Watkins.

Our most important current assignment is the development of the National Energy Strategy. This is, of course, not merely a Policy Office nor a Department of Energy task, but we are the primary office charged with building in and attempting to coordinate its construction.

Since last July when the President directed the Secretary of Energy to construct this strategy, we have been working very hard to put together a road map for future energy decisions worthy of the name "National Energy Strategy." We have conducted 15 hearings. We have heard from nearly 300 witnesses. We have received and analyzed over 1,000 written submissions from folks all across

the country and virtually every spectrum of academia, industry, and the private sector.

On April 2nd we expect to put out an interim report on this development process, which will describe what we have heard to date and tie up what we think to be the critical energy decisions facing us.

When it is completed in December of 1990, the first edition of the national energy strategy will contain specific short-term, mid-term, and long-term recommendations on how we can best balance energy, economic, and environmental requirements.

In addition to this massive effort, there is a new, Department-wide, internal planning process being instituted by the Policy Office to bring our programs and budgets in line with this strategy—in other words, to implement what kinds of decisions and policies we come up with.

By Fiscal Year 1992 we expect to have the Department's budget closely aligned with the approved National Energy Strategy. In addition to the NES, we are, of course, responsible for ongoing research and analysis and for providing new tools and expertise.

Now, much of our current activity analysis relates to environmental issues and their affects on energy. To support this analysis, in February of 1990 the Office of Environmental Analysis, formally located under the Assistant Secretary of Environment, Safety, and Health, was transferred to the Policy Office. The funds for this function, however, are still contained in the Energy Supply Research and development appropriation and are not represented in the budget request before you today.

The Policy Office is playing a lead role, along with the Assistant Secretary for International Affairs, in coordinating the Department's analysis of and response to the potential for global climate change. We are also coordinating the Department's participation in efforts to develop amendments to the Clean Air Act.

Speaking from the experience of many long days and short nights for both myself and the dedicated career staff in the Policy Office, I can tell you that these two areas, alone, are straining our analytical resources to the limit.

In addition, however, we are leading efforts on alternative fuels and on technology transfer. We are coordinating implementation of the Alternative Motor Fuels Act of 1988, we are managing the Interagency Commission on Alternative Fuels and the U.S. Council on Alternative Fuels, and we are assisting the Secretary in coordinating DOE's technology transfer efforts.

A particular action item before us right now is to implement the National Competitiveness Technology Transfer Act of 1989, which we are under a clock—I think within 30 days—to come out with regulations implementing that Act.

Thank you very much. This concludes my presentation and I look forward to your questions.

Mr. BEVILL. Thank you.

[The prepared statement of Ms. Stuntz appears at the end of the hearing record.]

Mr. BEVILL. The Chair recognizes Ms. Jameson.

Ms. JAMESON. Thank you for the opportunity to be here today and discuss our Fiscal Year 1991 budget request for the Office of Public Affairs.

The Office of Public Affairs was previously part of the Office of Congressional, Intergovernmental, and Public Affairs. We are now our own entity.

The budget request for Fiscal Year 1991 is $1,356,000 of which $1,314,000 is for salaries and expenses. We request $42,000 for contractual support and are requesting 22 FTEs.

Our mission in Public Affairs is to keep the press and the public informed of key energy issues and departmental activities.

Thank you.

Mr. BEVILL. The best statement of all. [Laughter.]

[The statement of Ms. Jameson appears at the end of the hearing record.]

HEATING OIL PRICES

Mr. BEVILL. Mr. Easton, you have been monitoring the world situation on fuel. It did make me think of this past winter down in Alabama when it was two degrees below zero. Out in the rural areas—the areas where most senior citizens live in my State—they were paying skyrocketing prices for heating oil.

Now, what happened and what are you doing? What do you recommend? Have you made any recommendations to prevent that happening again?

The old law of supply and demand obviously went into effect and then there was a little greed. The opportunity was there to get whatever the traffic would bear. They did that. I'm curious to know now what caused it and what you are doing about it.

Mr. EASTON. I would be happy to answer that, Mr. Chairman.

We were reviewing what was happening in December as the weather continued to stay colder than any December on record in this century. We became aware about the middle of the month through our monitoring and our contacts with the States that they were beginning to develop spot shortages in some parts of the country—initially in New England—of propane. And then that expanded to elsewhere in the country, including the difficulty that your constituents faced and elsewhere.

It became apparent that the continued cold weather was not going to abate and that the demand was incredibly high. The demand for middle distillate had gone up from something like three million barrels a day, on average, to over four million almost overnight, so that incredible demand was placing great strain on the system.

On the 23rd of December we convened at the Department of Energy, a meeting of all the people that could impact the supply and delivery system. We had State officials, we had other Federal agencies, we had the trade associations representing the components of the fuel system, as well as suppliers, themselves, of both propane and heating fuel.

Our primary goal at that time, when we were still in the grips of this incredible cold snap on the 23rd of December, was to make sure that the supply and demand system was working and that

nobody would go over the Christmas weekend, and over the Christmas holidays without heating oil or propane. Our first effort was to assure that, indeed, the system was working.

After that, of course, we found, as the supply and demand system started working, prices did go up. That caused the Department to initiate two studies. One was a very quick, short-term study undertaken to look at the last two weeks of December and the first week of January to look at what was actually happening in the pricing area. I think we sent that report up to Congress about the first part of February. It described everything we could see as to what had happened to date at that point.

That does not, however, contain profit data, because we have to wait until later in the year when the actual profit statements are out to determine whether untold or undue profits were made.

The report we submitted contains only information about margins and, of course, those can be somewhat inaccurate.

Let me also describe some other efforts that my office, as well as, the Department took, to assure that the system worked well and that the Federal Government was fulfilling its role to the citizens of the United States.

One of the concerns was whether we had enough supply available. Initially the problem started in New England. One of the problems was whether we could get foreign vessels waived from the requirements of the Jones Act. So we got together with our colleagues at Customs who grant those waivers at the Maritime Administration and at the Department of Defense to impress upon them the seriousness of the situation so that Jones Act waivers could be granted.

In addition, we worked with the ICC to free up rail cars to move product and propane. We worked with the State Energy Offices to assure that we were getting the most up-to-date information about the situations in their State, and we worked with the associations that represent the suppliers.

We are now in the process of conducting what we call "lessons learned" to see just what more can be done under the authorities that the Department has. As you know, the Department does not regulate price, nor do we control the allocation of product, but, consistent with the authorities we do have, we are looking at what we at the Department can do to assure that the system works as well as possible and that we do not adversely impact on the citizens.

Mr. BEVILL. Your statement is good but I notice with regard to taking advantage of the situation, you put that on the back burner. Can't you find out what they paid for the oil and how much they sold it for?

Mr. EASTON. The report that we delivered to the Congress, Mr. Chairman, does indicate what was paid and what was sold. We can't tell, however, until we do the second, more thorough report whether there were excessive or undue profits. One of the reasons that we don't have full data is because during that time there were numerous overtime hours that drivers were expending, there were extra costs that some of the companies were incurring, and so we can't tell just from the margin information we have whether the profits were excessive.

I did testify in one hearing when I was here in January. I said there were winners and there were losers. We know that some of our constituents were, indeed, losers in terms of what they paid for their heating fuel. What we are trying to do now is to determine who the winners were and make sure that the winners in this system were not doing anything illegal or excessive under the law.

Mr. BEVILL. Do you plan to pursue that? Do you plan to get the Justice Department involved if you find that they have violated the law?

JUSTICE DEPARTMENT INVOLVEMENT

Mr. EASTON. Mr. Chairman, the Justice Department already is involved. They have been reviewing the complaints they have received.

We recently had a meeting—"we" being the Antitrust Division, the Assistant Attorney General for Antitrust, the Chairman of the Federal Trade Commission and I—with State Attorney Generals to discuss where we were so far and what we were going to be continuing to do as more information comes in.

I think the Justice Department will be looking for the report that will be done later this spring by the Energy Information Administration, which will be more detailed in terms of whether there were excessive profits.

Mr. BEVILL. I hope you pursue that. This was a very, very difficult situation for a lot of people. I just mentioned the senior citizens out in those rural areas. They couldn't afford to pay the prices that they were getting hit with. We had to make arrangements for emergency funds in a large number of situations. It created a lot of problems.

I think if somebody was profiting off of that situation, then I think they ought to be prosecuted if they broke the laws. They certainly ought to be exposed. I think the people ought to know about it. I'd like to have a report on what you find.

Mr. EASTON. We will assure you, Mr. Chairman, that you will receive——

Mr. BEVILL. We had truckers—We have a lot of truckers that own one truck. That is their livelihood. The diesel fuel skyrocketed. They could not operate and even pay their expenses, and yet they were under contract. There were all kinds of complications.

I would like to make certain that it never happens again if this was just a greed situation. Certainly, with your monitoring, we ought to be able to prevent this happening again.

PRICE GOUGING

Mr. EASTON. At this point we can't tell you whether there was excessive greed or not, but we are certainly trying to do what we can to figure out whether there was.

I should say that there is only one State that actually has a law on its books that deals with price gouging, and that is the State of Connecticut. In the rest of our States—and, of course, at the Federal level—we must depend on our antitrust laws, and that requires some collusive behavior.

Mr. BEVILL. Maybe you might recommend an anti-gouging Federal law. That is possible if there are loopholes that need closing. There are lots of things you can do. There must be some answers to the problem. I don't think we, in this nation, ought to permit that kind of thing to happen again. I think we ought to take steps to prevent it and to prosecute those, if we can, that did it.

Mr. EASTON. Well, Mr. Chairman, I think that if the weather cooperates we won't have one of the coldest Decembers on record again.

Mr. BEVILL. I understand that, but I can tell you now we will have cold weather next winter. So you can anticipate that. I think that there is some hanky panky there. I just think that if you all are going to monitor and look after the energy situation in this country, I think you're in a very important position and you need to do something about it.

Mr. EASTON. We are aware of our responsibilities.

Mr. BEVILL. Then, at least put it in the hands of somebody that can, if you don't have the authority—the Justice Department, or whoever.

Mr. Wakefield—well, before I leave Mr. Easton, I wanted to ask you one other question.

Mr. EASTON. Yes, sir.

INTERNATIONAL PARTICIPATION IN THE SSC

Mr. BEVILL. On this Superconducting Super Collider we keep hearing about—well, Secretary Watkins just told us last year that he is contacting other countries to get them to participate in the tremendous cost. The cost has jumped up, since last year, $1.9 billion. He testified this time that he is going to make a second run on it. I assume that would be in your department. Are you the one that is making these contacts with these countries to get participation in this cost?

Mr. EASTON. The international part, yes, sir, will be within my department. We will——

Mr. BEVILL. And we are not getting much results. Everybody on this panel supports this very important scientific project. We are impressed with it, but we are also very concerned about the cost. We know that whatever scientific information that comes from it will be shared with the world. Even our atomic energy secrets were shared, even though we didn't want to. So we know what is going to happen, so we don't have to guess on that.

I think that it would help us—and certainly strengthen this panel's position on it—if we could get some results.

Mr. EASTON. As the Secretary and I think Dr. Decker testified earlier when they were before your committee, we will be implementing the international portion of the plan fairly soon. We have been holding up, as they have told you, because we wanted to make sure we had a firm figure on the costs. We wanted to make sure that the project was going to go forward. Now that we have those things ascertained, we can move forward to implement the international plan.

Mr. BEVILL. I noticed just this week that the Energy Department stated that they are not going to wait for any foreign participation

on the project, or words to that effect. I'm sure you read that. Is that an accurate statement?

Mr. EASTON. The only statement that I can refer to, Mr. Chairman, was the Deputy Secretary's statement on Monday of this week when I think he announced the project was going forward and we don't need to wait on any further—I think he was saying we don't need to wait for anything further. We can go forward now and there is nothing further to hold us up from implementing the international portion of the plan. I think that is what the——

Mr. BEVILL. Well, when you say "implementing the international plan," what does that mean? I am talking about money.

Mr. EASTON. That is to make calls on some of the key governments that we think will be supportive. As you know, we made contacts——

Mr. BEVILL. So that is not inconsistent with what has been said so far?

Mr. EASTON. That is correct.

Mr. BEVILL. So you are saying that it is still going and you still——

Mr. EASTON. It is still on going.

Mr. BEVILL. Are you getting any encouragement?

Mr. EASTON. The Deputy Secretary will probably lead the first mission abroad in June, and that is when we will get down to actually having discussions to follow up on the 1988 discussions we had which were when we sent preliminary teams out to determine the level of interest in 1988. Now we will sit down in the June visits and start negotiating on level of participation, degree of participation, and that sort of thing.

Mr. BEVILL. You might want to comment on that further in the record.

Mr. EASTON. I would be happy to.

[The information follows:]

SECURING INTERNATIONAL PARTICIPATION IN THE SSC

Before a delegation travels abroad to secure international participation in the SSC, an information cable will be sent to our embassies in countries that this Department visited in 1988 giving them an update on the status of the SSC project. In addition, we are also preparing cables to these embassies which will outline timeframes for the proposed visits and solicit embassies' views on appropriateness of the planned approach with the governmental officials as well as any other relevant information that would aid mission preparations prior to departure. The composition of each mission visit will be tailored to the country being visited. A schedule detailing country by country visits for the months ahead is being developed, but will be subject to change depending upon the specific availability of the key officials being contacted.

Ultimately, my office will have the responsibility for drafting the international agreements under which foreign governments will participate in the SSC. We will obviously be working jointly with the Office of Energy Research in the negotiations process and in obtaining the necessary intra- and inter-agency clearances for approval of the final agreements.

Mr. BEVILL. We are moving on this bill, and we need to know something more definite than we have received so far.

FERNALD SETTLEMENT

Mr. BEVILL. Mr. Wakefield, the Secretary of Energy, Secretary Watkins, wants to reprogram $16 million for the Fiscal Year 1990

Atomic Energy Defense Activities appropriation to provide initial payment for the settlement arrived in the Fernald litigation. We are talking about $73 million in the settlement, I understand, that your office worked out—you and the Justice Department.

Mr. WAKEFIELD. That is correct.

Mr. BEVILL. I don't think anybody is questioning the feasibility of the settlement or the amount of the settlement or any of that, but we do need assurance that the Energy Department has authority to do this. We don't pay claims.

Mr. WAKEFIELD. No. This particular settlement was made by the Secretary under the authority of the Price-Anderson Act on behalf of the contractor.

Mr. BEVILL. So you have no doubt in your mind, that the Secretary of Energy has this authority?

Mr. WAKEFIELD. Mr. Chairman, I have no doubt in my mind, and that view has been confirmed in writing by the Justice Department and the General Accounting Office.

Mr. BEVILL. I understand that the court—participated in some nine days of hearings shortcut in Federal hearings—and that this was also approved by the court.

Mr. WAKEFIELD. It has been approved——

Mr. BEVILL. Federal Court.

Mr. WAKEFIELD [continuing]. By the court both as to the fairness of the settlement for the class and as for the Secretary's authority. He made the specific finding that the Secretary did have authority under Price-Anderson to make the settlement.

Mr. BEVILL. And the only further exposure as far as the government will be concerned is the possible $5 million added to the $73 million?

Mr. WAKEFIELD. That is a potential contingency, Mr. Chairman, that, in the event that certain property owners make claims and they are validated, up to——

Mr. BEVILL. But $78 million would be the limit under any——

Mr. WAKEFIELD. Plus the interest that might accrue as it is made over time. He set the interest at 10 percent. But that is the limit as to this suit. It would not cover Superfund cleanup obligations which we had in any event, and it would not cover provable personal injuries by any members of the class.

Mr. BEVILL. Well, we are going to want a very good brief on this, particularly for the future. Apparently this thing is pretty well closed out now and the courts approved it and you have taken and the Federal Court has taken the position that the Secretary of Energy has this authority. We would like something to back us up on this for future purposes. We don't want to get in a position of starting into a new area of paying claims when this has always been handled by the Justice Department. That is what I am really saying.

Mr. WAKEFIELD. I understand that, Mr. Chairman. The difficulty here is that it wasn't the U.S. Government that was sued, but our contractor, and we have a requirement to indemnify them under the contract. So the Justice Department was of the view that this did not come within the Judgment Fund.

Mr. BEVILL. The Chair recognizes Mr. Myers.

Mr. MYERS. Thank you, Mr. Chairman.

I think all of us are troubled with this reprogramming. As the chairman has said, it is the precedent that we are setting that really concerns me.

If the Secretary does have the authority and I am assuming right for this moment that he does have. You have been advised so by the Justice Department. But the procedure, itself, is something that, as the chairman has said, I think is very dangerous for the future.

If a Secretary—whether it be the Secretary of Energy or whoever it is—has the authority to go out and make settlements, that places the Congress in a very precarious position if we have to fund it.

In this particular instance, when the Secretary made this agreement what was the plan for funding the settlement?

Mr. WAKEFIELD. I'll need to give you just a bit of background on that, Mr. Myers.

Mr. MYERS. That might help.

FERNALD SETTLEMENT BACKGROUNDS

Mr. WAKEFIELD. We had had a non-binding summary jury which determined, after hearing a week or so of testimony in summary form, that we owed—they found us liable and found total damages in the amount of $136 million. So we thought it appropriate to arrive at a settlement, and we thought at the time, and still do think, the settlement, itself, was very good.

The settlement was made at a time when trial was imminent and the judge had indicated that we were going to trial in the regular trial setting within a matter of days if we didn't settle the case, so we were under extreme pressure to settle the case.

We arrived at a memorandum of understanding. The Deputy General Counsel, who had tried the case acting under general instructions from the Secretary, entered——

Mr. MYERS. He tried the case?

Mr. WAKEFIELD. He had tried the summary.

Mr. MYERS. Okay.

Mr. WAKEFIELD. And he was prepared to try the case, itself, if it had not settled and gone forward last summer in trial.

He entered into a memorandum of understanding with the plaintiffs for the settlement. This, like most memorandum, was very brief in form and contained no provision as to the funding of the settlement.

Had we proceeded, as was planned, to enter into more definitive settlement agreements, those settlement agreements would have set forth in detail just how the funding was to take place. However, we were never able to arrive at definitive settlement agreements, and at this point last fall the judge said, "Well, we have a settlement agreement. Your memorandum of understanding is a settlment agreement and the Department of Energy is bound by it and you will pay by October 15."

So all of this was done in the context where we did not have an opportunity to go through the whole process—the whole normal appropriations process—which normally I think we would have done. If the situation arose again, I can assure you we are not going to get ourselves in this box where six months later we are now under

a mandate by the court to come up with the money today, in effect, or the judge is going to hold the Department in contempt tomorrow.

Mr. MYERS. We have a lot of Federal judges out there that are very arbitrary, as you well know, and do not understand the system. I wonder how he would enforce his contempt and how he would force the Congress to appropriate the money. What would be his action, do you think, if we did not agree to this reprogramming?

Mr. WAKEFIELD. I don't know, Mr. Myers. He has previously ordered the Secretary to appear in his court and it took action by the Justice Department to prevent that from happening. I have no way of predicting what this particular judge will do.

Mr. MYERS. Where was this court?

Mr. WAKEFIELD. Cincinnati, Southern District of Ohio.

Mr. MYERS. Seventh District of Ohio?

Mr. WAKEFIELD. Southern District of Ohio. Yes. It is Federal Court.

Mr. MYERS. I assumed it was Federal. It seemed to me that at some point before now, the Congress should have been included in this settlement. This was a settlement out of court and the court just has agreed to it and approved it; is that right? It was not court-directed or ordered?

JUDGMENT FUND

Mr. WAKEFIELD. It was a settlement agreement reached between the parties and then ultimately set for a fairness hearing by the judge and approved by the court. Our thought at the time was that the money would be paid out of the Judgment Fund, and we did ask Justice to pay it out of the Judgment Fund, but after some consideration they determined that it was not appropriate.

Mr. MYERS. Well, the thing is, we've got to take money from some other program. We have to rob Peter to pay Paul, and that disturbs me very much. I wonder, if Congress sets up this Judgment Fund for that purpose, to pay judgments——

Mr. WAKEFIELD. Yes.

Mr. MYERS. And this is actually a judgment. It may not be considered by the Justice Department. If the judge should rule that we are in contempt, would that be a judgment? Did Justice say it couldn't be paid from the Judgment Fund, or was it OMB?

Mr. WAKEFIELD. No. Justice said that it could not be paid from the Judgment Fund, and we have a written opinion to that effect, because the United States was not a defendant in the case.

Mr. BEVILL. An opinion by whom?

Mr. WAKEFIELD. By the Office of Legal Counsel of the Justice Department, which was concurred in by the Deputy Attorney General.

Mr. MYERS. If there is a contempt citation here, would that be against the United States or would that be against the contractors?

Mr. WAKEFIELD. I would assume that the court would not enter a citation directing the United States to pay any money. I don't know the nature of any contempt citation it would issue against the Secretary other than the plaintiff's attorney has asked that the

Secretary and the Department be asked to show cause why we have not made the payment.

Now, what the remedy would be I don't know.

Mr. MYERS. Well, the thing that disturbs me very much: if every agency had this authority and every court could direct an agency to pay, we would lose complete control of the budget process. Now, we have judges around the country that want the former President of the United States to appear in their court for prestigious reason. We have had courts around the country directing the Federal agencies or Federal entities to pay out judgments or pay out what they think. I would see us in Congress being wagged by the tail.

Mr. WAKEFIELD. Well, I think, Mr. Myers, in most instances the United States would be the main defendant in the case so the Judgment Fund would be the appropriate source for the money to be paid. We are in the unusual circumstance that I don't think many, if any, other agencies have of having our nuclear work done by contractors and our being required, under the terms of those contracts, consistent with Price-Anderson, to indemnify them.

Mr. MYERS. Well, there are a great many agencies that do business with contractors—the Corps of Engineers and—well, every agency I think contracts out work to be done. How many other contracts does the Department of Energy have indemnifying the contractor?

Mr. WAKEFIELD. Virtually all nuclear contracts do.

Mr. MYERS. So we are really opening up something where every court in the country can cite this is precedence and direct payments. We are going to have a test to find out what is going to happen.

Mr. WAKEFIELD. I hope not. I don't believe we are, in the first place, because a settlement has no precedential value, while a court decision adverse to the Department would have had a bad precedential value.

Mr. MYERS. Well, the payment, itself, is a precedence as far as I am concerned. The court has approved it. It may not be court-directed, but the court has approved it, hasn't it?

Mr. WAKEFIELD. Yes.

Mr. MYERS. Yes. So there is some precedence, the way I see it.

Mr. WAKEFIELD. Well, I think in the future we are going to try to handle these in different fashions.

Mr. MYERS. I hope so.

Mr. WAKEFIELD. I don't believe we are going to be making settlements in the future without making sure we know where the money is going to come from at the time the settlement is made.

Mr. MYERS. I am concerned about the exposure we presently have. You say virtually all your contracts have a similar provision that the Department of Energy will indemnify all contractors against any judgments. Was there a judgment? Did the contractor have a judgment against him, or was it just a——

Mr. WAKEFIELD. There was a settlement, yes.

Mr. MYERS. There were judgments entered?

Mr. WAKEFIELD. The "judgment" that is entered is that there is a binding settlement.

Mr. MYERS. Against the contractor? The judgment is against the contractor?

Mr. WAKEFIELD. It is against the United States, because we made the settlement. That's the way the judge entered it. As I indicated, that was only a memorandum of understanding, but that is the ruling of the court. The Justice Department has indicated we do have a binding settlement.

Mr. MYERS. If the judgment is against the United States—well, we will stop taking the time of the committee here, but I am still not satisfied with where we are getting here.

We all know about supply and demand. Of course, Congress has tried to circumvent supply and demand rule for many, many years—unsuccessfully, I might add. What happened last December was a nationwide cold streak. Was there truly a shortage of liquid propane and fuel oil in the country, Mr. Easton?

PROPANE AND FUEL OIL SUPPLIES

Mr. EASTON. There was not a shortage in terms of overall supply. There were developing some spot shortages, however, to certain——

Mr. MYERS. Dislocation of supply then?

Mr. EASTON. Exactly. Primarily because of transportation difficulties, pipeline capacities, failure of ships to arrive on time. If you recall, there was that massive oil spill off of Morocco where the Iranian ship—that ship was damaged in a storm that also damaged a ship called the *Hesperus* that was due to arrive in New England. Some people say if that ship had arrived this whole thing might not have started. But that ship, having something like 10 million gallons of propane coming from Algeria to New England, didn't arrive. They had to start increasing the uplift in the pipeline to New England. The weather continued to get colder. Then you had freeze-ups both in some of the wells in Texas and offshore. You had some barge traffic disrupted on some of the midwestern rivers. All of these transportation problems caused some spot shortages.

Overall, however, in early January there was a surplus of propane after the product started moving to where the higher prices were.

Mr. MYERS. Did the price come back down then?

Mr. EASTON. The price has been coming down. It did not come down right away in January.

Mr. MYERS. It has been rather slow.

Mr. EASTON. In heating oil it has. If you look at where we went into the heating system where we are now, propane is still a little bit higher.

Mr. MYERS. I don't heat by propane but my son-in-law and daughter do, and their prices—I think they said it was one-third more than it was a year ago.

Mr. EASTON. Part of that increase is due to higher crude oil prices than a year ago. We have to adjust. Of course, all pricing is tied basically to crude, so we have to adjust the 1990 to 1991 season for what crude is versus what it was back a year ago. So part of that price is due to the higher price of crude.

Mr. MYERS. Now, you said you were examining the profits that were realized during this period of time. We all know profit is nec-

essary. What happens if they did make a big profit? What authority do you have to do something about it?

Mr. EASTON. Short of some form of collusion that appears from the record—if we are looking at a number of companies that all show similar movements, you may be able to infer from that some sort of fixed pricing behavior. But absent some evidence of collusion or some concerted behavior, there is no law at the Federal level that would deal with this situation.

Mr. MYERS. As you have identified only one State has.

Mr. EASTON. That is correct.

Mr. MYERS. For years we tried to fix prices and found out it didn't work—price controls on natural gas and oil. I think we have tried to get away from that. I am for free enterprise, but gouging no one likes either. But yet I don't know what the answer to it is, but we are concerned about it.

Mr. EASTON. Well, one of the——

Mr. MYERS. Supply is the answer. Competition.

Mr. EASTON. Definitely. Certainly none of us feels very comfortable when we see our fellow citizens—especially those who can't afford it—facing incredible run-up in prices. The one thing we should remember, however, is the market system has worked very effectively to keep prices and supplies balanced. If you look at a period of several years, the system has worked well to keep prices low compared to historical levels. When you do have run-ups like this, probably the real answer is to have State and Federal programs that provide assistance financially to those who can least afford it. Keep the free market working as it works best, keeping price levels low. But then, when prices do go higher than anyone is prepared and capable to pay, have some sort of emergency program such as exists at State and Federal levels to handle that situation.

Mr. MYERS. I have one more question.

ROLLING BROWNOUTS BY UTILITIES

All the shortages were not necessarily in LP or fuel oil. I happened to be in Florida during the Christmas holidays, and we had rolling blackouts. Right across the canal from where I was staying the lights never went out, but our lights were off where I was. The lights or power was off for about an hour or hour and a half. This reverses what they were advertising they were doing. Everyone I talked to had brownouts. Now we are advised this summer we are likely to have more brownouts.

What responsibility does a public utility have to not let this happen?

The temperature got down to where it was almost freezing in Florida, and then one night it did get down to freezing, and they had rolling blackouts for about 48 hours. In the third day they were still having these rolling brownouts. We could look across the bay and see where the utility—one of the stacks never did have any smoke coming out of it.

What do we do with the utilities that just don't accept the responsibility? What authority do we have to do something about it?

Mr. EASTON. I think it is a complicated situation, Mr. Myers, because the utilities, indeed, do have that obligation to provide serv-

ice, and sometimes they take these actions of brownouts or, in the case of Florida and Texas, rolling blackouts to try to make sure the whole system doesn't shut down, to make sure the system does remain in place all of the time or practically all of the time for all of its customers. In Texas there was a study done afterwards that said that if the utilities hadn't shut down with their rolling blackouts when they did, the whole system might have gone down in another five or ten minutes, one analyst said.

So, what we are doing is part of what Linda Stuntz is doing with the National Energy Strategy. At the Department she is coordinating—looking at this whole system and how our energy sector interrelates. We, at the Department, have been very concerned about electrical capacity, especially on the East Coast—the Northeast and in Florida—because our margins there are very, very tight, the lowest that they have been in years. In some cases we think at lower levels than they should be.

It is through both the setting of a good Federal policy and trying to get the States to realize that increased power requirements are needed—the State utility regulators, State governors to step in and take the appropriate stances. In other words, it doesn't help us very much where we have brownouts in the Northeast and have utility plants like Shoreham that aren't operating.

Mr. MYERS. But they have the capacity and are not using it. They are sending a message that they've got to get prices up or they'll brown everybody out? When that smokestack didn't have any smoke coming out of it I know they had generation that they weren't using. Was there some reason for it? Did anybody ever look at this? Or are they just trying to send a message?

Mr. EASTON. Utility regulators——

Mr. MYERS. I sympathize with utilities sometimes, but I didn't then.

Mr. EASTON. Utility regulators in both——

Mr. MYERS. Somebody else's utility I sympathize, but——

Mr. EASTON. The regulators in both Florida and Texas have looked at this very extensively. In some cases their systems went down because of mechanical problems due to the cold weather. They are trying to get at the bottom of this. But in some cases let me say it is the utility regulators, themselves, that have to take changes in their stances so that we can allow new generation and transmission capacity to come on line. There are just too many road blocks thrown up to the utilities these days in coming up with new generation.

Mr. MYERS. I agree with that. But it seemed strange to me that in Florida, where we got down to 30 degrees, we had brownouts and blackouts. Up in Indiana where it was 25 degrees below zero we didn't have any brownouts.

Mr. EASTON. The system capacity. It is a difference in capacity.

Mr. MYERS. The utility is not accepting its responsibility then for the capacity, is it?

Mr. EASTON. I'm not going to——

Ms. STUNTZ. If I could just add one thing?

Mr. MYERS. Sure.

Ms. STUNTZ. Much of the capacity in Florida—and maybe the plant that you were looking at—is dual fire between oil and gas.

There is only really one major pipeline that goes into Florida. Floridians years ago fought off and are still fighting any attempts to build additional gas pipeline capacity into Florida.

I don't know for sure, but I do know that there were instances where utilities were basically cut off of their supplies of natural gas so those supplies could be diverted to homeowners, and heating oil. The other choice, was also in a situation where it was being diverted to places where it was truly needed—to homeowners, in particular. So that may well have been why you didn't see any smoke coming out of that smokestack.

Again, I don't know for sure, but I do know most utilities were disrupted and there is very limited gas pipeline capacity into Florida. It is a problem they continue to have.

Mr. MYERS. They burn coal.

Ms. STUNTZ. Right.

Mr. MYERS. It is not Indiana coal either, I might add. It might have been better off if they had.

Mrs. BOGGS. We have to vote, unfortunately. We will try to catch the vote and be right back. We will take a brief recess.

[Recess.]

Mr. BEVILL. The committee will come to order.

CONGRESSIONAL AND INTERGOVERNMENTAL AFFAIRS

Mrs. Brown, would you describe the efforts of the Department's Division of Consumer Affairs? What is your goal, and just what do you do?

Mrs. BROWN. Mr. Chairman, our Office of Consumer Affairs is within the Office of Intergovernmental Affairs and Public Liaison. We have five FTEs who spend their time preparing publications and public service radio announcements to make sure that the public and private sector groups are aware of the activities of the Department and are kept abreast of our goals and our objectives as we pursue some of our programs.

Mr. BEVILL. All right. If you want to, you may want to expand on that in the record.

Mrs. BROWN. I certainly will.

[The information follows:]

OFFICE OF CONSUMER AND PUBLIC LIAISON

The Division of Consumer Affairs was reorganized as the Office of Consumer and Public Liaison. This office traditionally has been responsible for providing information on a variety of energy issues to consumer groups and the general public. We distribute publications; broadcast a monthly radio show and produce consumer news columns and public services announcements for consumer education information on energy efficiency, conservation, and DOE initiatives for radio and newspapers.

We are working closely with the Office of Policy, Planning and Analysis to ensure a broad representation of consumer and industry perspectives at public hearings that were held throughout the United States concerning changes to our national energy strategy. Our outreach efforts have encouraged many consumer and energy-oriented organizations to present testimony at these hearings.

We are continuing to improve the accessibility of all external groups to the Department of Energy officials and programs.

OFFICE OF MINORITY AND ECONOMIC IMPACT

Mr. BEVILL. Ms. Wray, I wish you would describe the rationale for a decrease in your 1991 program. I was a little surprised to see

that. What is the reason for decreasing the amount of money requested by the budget?

Ms. WRAY. It is my understanding, Mr. Chairman, that there was an additional $759,000 added to the Fiscal Year 1990 budget and that is the reason for the decrease in the 1991 budget request.

Mr. BEVILL. Is that the difference between 1991 and 1990?

Ms. WRAY. That is correct.

Mr. BEVILL. So they did not again request the $759,000. What was the $759,000 for?

Ms. WRAY. Mr. Chairman, I'm not sure of the exact purpose.

Mr. BEVILL. You can put that in the record.

Ms. WRAY. No problem.

[The information follows:]

DECREASE IN FISCAL YEAR 1991 PROGRAM

In FY 1990, an increase of $759,000 over the Presidential Budget request of $3,415,000 was added to the budget appropriated by the Congress; bringing the total FY 1990 request to $4,174,000.

The $7,072,000 estimate for FY 1990 includes prior year unobligated funds of $2,885,000. These unobligated funds reflect the previous MI's Director's decision not to initiate the undergraduate educational program, not to continue funding for the Socioeconomic Research Program, and not to initiate the Business and Community Economic Development Program.

A proposed reprogramming of $2,885,000 increases the FY 1990 request to $5,629,000 for Management and Technical Assistance Programs. If this reprogramming occurs, a projected $1,200,000 will be obligated in FY 1991. Based on this approval, the actual amount of funding available for FY 1991 would be $4,648,000. This amount would be greater than the $4,174,000 appropriated for FY 1990.

POLICY, PLANNING AND ANALYSIS

Mr. BEVILL. Ms. Stuntz, would you describe some of the major energy policy issues you are developing and describe how these are implemented by the program offices?

Ms. STUNTZ. Mr. Chairman, we attempt to work as collaboratively as possible with the program offices, and we really have to, to try to take advantages of the resources and expertise they have. It works both ways. There are some things that we have lead responsibility for and we work with them. One of them has been Alternative Motor Fuels Act analysis.

There are other areas—for example, clean coal technology—where fossil clearly has the lead but we try to assist them—for example, where they need help with environmental issues where there is now more expertise in the environmental shop.

So it is a collaborative process. The Department is now organized so that the Policy Office and most of the offices with whom we do the most business all report to Deputy Secretary Moore, and through his office then we can sort of make sure we stay coordinated. Of course, nobody is ever perfect at that, but I think we are doing a pretty good job.

Mr. BEVILL. This does prevent overlapping and permits the consolidation of ideas, I guess.

Ms. STUNTZ. We are trying. The program offices feel the need to have some policy support of their own, and I think that is important, but we do attempt not to duplicate efforts and I think that is a priority of the Deputy Secretary.

PUBLIC AFFAIRS

Mr. BEVILL. Ms. Jameson, would you describe the Office of Public Affairs' effort to review all Departmental publications? Does this include review of publications distributed in the field and by the Department's laboratories?

Ms. JAMESON. Yes, sir, it does. We review all the publications to ensure that they are consistent with DOE policy, that they are accurate, that they are cost effective and non-promotional. And we do review the publications from the field and the labs, except for technical. We review the public document brochures.

INSPECTOR GENERAL

Mr. BEVILL. Mr. Layton.

Mr. LAYTON. Yes, sir.

Mr. BEVILL. It is directed by legislation that DOE budget request a separate appropriation for the Office of Inspector General. Describe the expected advantage of having a separate appropriation for the Inspector General.

Mr. LAYTON. The separate appropriation in the minds of many will give the Congress better visibility of the funds being spent by inspectors general. It will not become diffused in the process of going through the departments and OMB—you will see what we request, how much we get, and how we spend it.

Mr. BEVILL. Is this an effort to make you more independent?

Mr. LAYTON. By some, yes, sir.

Mr. BEVILL. And so this is to satisfy the inspectors of the inspectors.

Mr. LAYTON. I would agree.

Mr. BEVILL. All right. Mr. Layton, provide a detailed description of the monetary recoveries indicated in your budget and describe how these recoveries were dependent on the actions of the IG.

Mr. LAYTON. I would be more than happy to. I'll submit that one for the record.

Mr. BEVILL. All right.

[The information follows:]

MONETARY RECOVERIES

In FY 1989, the Office of Investigations reported monetary recoveries of $616,797. The Office of Audits issued 348 audit reports, including: 256 internal audit reports recommending a total of $615.9 million in funds be put to better use; and 92 contract and grant audit reports identifying $8.8 million in questioned costs and $12.2 million in unsupported costs. This total of $21.0 million of potential recoveries is reflected in the FY 1991 budget request. A listing of these recoveries is shown in Appendix A of both semiannual reports to the Congress for FY 1989. A list of other recoveries as well as examples of some of the larger recoveries that occurred in FY 1989 are shown in a table which I would like to insert in the record. (The information follows:)

FY 89 INVESTIGATIVE RECOVERIES

Case Numbers	Case Subject	Amount (in whole dollars)
I89AL003	Travel Voucher Fraud, TSD, ALO	$ 3,390
I89AL008	Theft of Wire, Pantex	2,200
I88AL014	Fraudulent Labor Charges	6,281
I89DN001	Energy Materials Corp-Theft	88,359
I85SR004	Bribery Dupont Employee SRP	206
I88NO009	Weatherization CENLA	20,000
I89AL022	Theft of Govt. Property - LANL	1,229
I89DN008	Imprest Fund Theft, WAPA	9,664
I85DN001	Fraud Rocky Flats Plant	7,106
I88HQ015	Abuse/Gifts - Grat-Alcohol Fuel	260
I89HQ012	Theft Government Property	144
I88OR009	SYSCON Engineering Company - Fraud	36,503
I89OR022	VION Corp-Prod-Substitution FLS-C	365,000
I87RL011	BPA Employee - False Claims	4,419
I87SR014	Double Billing/Inflated Cost	71,032
I89SR018	Wackenhut Services Employee FLS	347
I89SR028	Subcontractor Employee Theft of Government Property	657
	TOTAL	$616,797

EXAMPLES OF INVESTIGATIVE RECOVERIES

Case #I89AL008

In January 1989 the OIG received information that 2,200 pounds of copper wire had been stolen from the DOE's Pantex Plant and sold to a scrap metal company in Amarillo, Texas. The investigation revealed that a contract Security Inspector removed the wire from the plant site using a government vehicle and hid it in a nearby drainage ditch. After work hours the Security Inspector and two friends transported the wire in a personal vehicle to a scrap metal company and sold it for $2,200. During an interview, the Security Inspector admitted to the theft and stated that his two friends, one of which is also a Security Inspector, were not involved in the actual theft. He repaid the $2,200 and resigned his position with Pantex. On July 6, 1989, the Security Inspector signed a Pretrial Diversion Agreement with United States Attorney's Office. Conditions of the agreement prohibits employment with another law enforcement agency and a mandatory six months participation in an alcohol treatment program. The other Security Inspector was suspended without pay for one day for failure to report the theft and sale of the copper.

Case #I89AL022

In June, 1989 OIG received allegations that 2,000 pounds of aluminum had been stolen from the Los Alamos National Laboratory, (LANL), Los Alamos, New Mexico. Investigation disclosed that the aluminum had been taken by a LANL employee and loaded into his personal vehicle and transported to his residence in Los Alamos. The following day, the employee sold the aluminum at a scrap metal company in Albuquerque. During an interview the employee denied any involvement in the theft. Later the OIG received $1,229 in cash along with an anonymous note in the U.S. Mail. During a second interview the employee admitted stealing and selling the aluminum. The employee also admitted sending the cash in an attempt to end the OIG investigation. The employee was terminated and the matter referred to the Assistant United States Attorney, Northern District of New Mexico, for prosecutive consideration.

Case #I89DN008

On March 27, 1989 OIG received allegations that the Western Area Power Administration's (WAPA) office in Billings, Montana had a shortage of $9,227.14 from the Imprest Fund. Investigation revealed the suspect to be a WAPA employee. The employee denied stealing the money but the investigation revealed the employee knew of the money shortage and had been falsely certifying cashier accountability reports from November 1988 through the end of March 1989. An audit of the imprest fund revealed a total shortage of $9,664.88.

On June 21, 1989 the employee was served with a bill for collection for $9,664.88 as authorized in 5 USC 5512. On September 14, 1989, the employee signed a 12 month Pretrial Diversion Agreement for violation of 18 USC 1001, False Statements.

Case #I88OR009

On January 1, 1988, the OIG received a complaint from the United States Attorneys Office, Birmingham, Alabama that Syscon Engineering Company, Birmingham, Alabama, received Government funds to perform energy audits and technical analyses on seven school systems under the Institutional Conservation Program (ICP) and never completed the work. OIG investigation determined Syscon Engineering improperly billed the seven school systems for $36,503. Further review by the DOE Atlanta Support Office of the Syscon Engineering Company identified an additional $200,000 in mischarging. As a result, the DOE Atlanta Support Office has directed the Alabama Department of Economic and Community Affairs to recover the funds from Syscon Engineering.

Case #I89OR022

In December 1988, Vion Corporation, Washington, D.C. was awarded a $10 million contract to provide new Hitachi and IBM Computer equipment to Martin Marietta Energy Systems (MMES) a prime contractor to the Department of Energy in Oak Ridge, Tennessee. MMES received the first shipment of hardware valued at $1.5 million that was installed at the DOE facility. When a second shipment arrived, it was determined that the equipment was not new as specified by the contract. A check of equipment received in the first shipment revealed that part of that installed equipment was also used.

IG investigation disclosed Vion Corporation ordered used/refurbished equipment after being told by MMES officials that only new equipment in current production would be accepted as provided in the contract. Vion Corporation agreed to provide upgraded technology valued at $365,000; removed the old equipment from the MMES facility; and provided additional warranty guarantees, all at no additional cost to MMES, in order to continue with the contract. The U.S. Attorney Office declined prosecution since no claim was submitted to MMES and because of the favorable administrative recovery.

Mr. BEVILL. How much of the manpower and dollars are directed by the IG to audits of environmental safety and health? This is going to be the environmental decade now, you might say starting this week.

Mr. LAYTON. We have increased the amount of funds expended. I believe in Fiscal Year 1989 about 12 percent of our effort that has gone into the environmental health and safety area. I'll make sure that is right for the record.

Mr. BEVILL. Also, provide in that record, if you will, the same information for 1989 and 1990 and 1991——

Mr. LAYTON. Yes, sir.

Mr. BEVILL [continuing]. So we can compare those figures.

[The information follows:]

RESOURCES DEVOTED TO ENVIRONMENT, SAFETY AND HEALTH AUDITS

In FY 1989 we planned about 5.8 staff years of audit effort in the ES&H area, and for FY 1990 this figure has increased to about 9.0 staff years. Additional projects will be scheduled during the remainder of the year as time and resources permit. Primary emphasis in these audits has been compliance with the Resource Conservation and Recovery Act and other legislation, environmental training within the Department, and a review of the management of selected clean coal technology agreements. Our level of audit effort in the ES&H area for FY 1991 depends, to some extent on the results of current audits; however, we anticipate about the same level of effort as in the current year.

NUCLEAR WASTE POLICY ACT

Mr. BEVILL. Mr. Wakefield, would you describe the legislative work associated with the Nuclear Waste Policy Act?

Mr. WAKEFIELD. Mr. Chairman, at this time there is no ongoing legislative work. We have in the past considered—and may again in the future consider—whether we need legislation involving the Monitored Retrievable Storage system to, in effect, decouple that from the permanent repository. In addition, we have initiated litigation against the State of Nevada to compel them to act upon our applications for permits, so that we can get on the site, and characterize it. If that litigation either is not successful or moves too slowly we may have to seek legislation to handle that problem, as well.

Mr. BEVILL. Mrs. Boggs, can you assume the chair?

Mrs. BOGGS. It really is wonderful to see the combination of the types of persons before us who have the multiple responsibilities that you have in such an important area of our government. It is a thrill to me to see you here.

OFFICE OF MINORITY AND ECONOMIC IMPACT

Ms. Wray, the budget for your office has decreased slightly for the fiscal year 1991 appropriation. Is it adequate to vigorously carry out the mission of your office?

Ms. WRAY. Yes. The budget has decreased from Fiscal Year 1990 and there were some changes in that. What I would like to do is submit responses accurately to you for the record.

Mrs. BOGGS. All right.

[The information follows:]

FISCAL YEAR 1991 BUDGET

The amount of funding requested for FY 1991 will be adequate to assure continuation of the overall development of the programs, as required by Office of Minority Economic Impact's legislative mandate, and improvements in the efficiency of the operations of the office. A continuous effort is being made by MI to observe the Secretary of Energy's directive to examine all programs according to his National Energy Strategy and major new goals and initiatives. Upon completion of this process, a request for supplemental funding will be submitted, if it is determined that additional funds are necessary.

Mrs. BOGGS. Does the charter for your office include outreach to women-owned businesses? Do you make any effort in this area?

Ms. WRAY. There isn't that responsibility for the office specifically, but I still do that. Yes. No, it isn't mandated.

Mrs. BOGGS. But you know the Fiscal Year 1990 Energy and Water Act sets a goal of at least 10 percent participation by historically black colleges and socially and economically disadvantaged individuals—including women——

Ms. WRAY. Yes.

Mrs. BOGGS [continuing]. And businesses in the Superconducting Super Collider project. What role does your office have in achieving that objective?

Ms. WRAY. We are just in the process of working very closely with other offices in the Department to achieve a more responsible role.

Mrs. BOGGS. I was interested in one of the bullets in your testimony that financial assistance is provided to minority business enterprises by enhancing the level of operating capital in minority financial institutions through purchases of certificates of deposit and this enables them to assist minority businesses and minority communities.

Ms. WRAY. Yes.

Mrs. BOGGS. Can you expand on that a little bit?

Ms. WRAY. There is a program in my office, the Financial Banking Minority Assistance program, that does exactly that. My office, in conjunction with the Department of the Treasury, recruits minority banks to participate in this program. We pass through to them Certificates of Deposits of $95,000 in their banks in hopes that they will use that money to make loans to the minority community.

Mrs. BOGGS. That is something that is very, very encouraging. I am delighted to hear that.

In the minority honors training and industrial assistance program you provide scholarships to approximately 350 financially-needy minority honor students——

Ms. WRAY. That is correct.

Mrs. BOGGS. Energy and technology-related training at two-year post-secondary institutions is to increase the technical labor base in the industry sectors. Are those institutions spread pretty fairly around the United States?

Ms. WRAY. Pretty fairly around the United States. Yes. There is a community college in Hawaii, New York City, the State of Nevada, Mississippi. They are spread throughout the country.

Mrs. BOGGS. It is a very consoling situation to those of us who have historically black universities and colleges in our areas to know that you do have so supportive a program. Also, the two-year

college, I think that you will find that there will be many of those that are located in areas where there is a large minority population. We all know that by the year 2000 it will take 18.5 years of training to hold the kinds of jobs that are going to be available. And so not only for the sake of the young people who will be trained, but also for the sake of the productivity of the United States, I would hope that you could expand that program into those areas.

Mr. Tarro, you may have to do this for the record, but would you please provide a brief summary of the activities of the Madrid Louisiana Fossil Fuel Field Office? Tell us what its mission is and what the near-term goals are for the office.

Mr. TARRO. Madam Chairman, I will have to provide that one for the record. I am not familiar with it.

Mrs. BOGGS. Thank you.

[The information follows:]

METAIRIE SITE OFFICE

DOE's Metairie Site Office (MSO) in Louisiana provides support for the implementation of the oil and gas research program. The Metairie Office was staffed in FY 1989 as a result of the FY 1988 Conference Report accompanying the Continuing Resolution which required the Department to establish a field office for gas and light oil research in Metairie, Louisiana. MSO's mission is to be the focus of the hydrocarbon research and development programs in the southeastern U.S. for the Office of Fossil Energy (FE), with a primary mission in light oil activities. MSO is devoting attention to technology transfer activities as well as management of selected research projects. MSO also has lead responsibility for the Historically Black Colleges and Universities Program with FE. As the implementation of the new Hydrocarbon Geoscience Research Strategy progresses during FY 1990, it is expected that additional areas of responsibility will be assigned to MSO.

Currently, Metairie is staffed with six full-time personnel who are managing the following: Improved gravity drainage oil mining project ($2.8M for FY 1990, $.9M for FY 1991); the Historically Black College and Universities Program ($.5M in FY 1990 and FY 1991); and the Louisiana State University (LSU) CO_2 injection for Light Oil Recovery Project ($250,000 of carryover funds). In addition, in FY 1990 and FY 1991 $350,000 is provided from the ETC Program Direction account for salaries, benefits, travel, and maintaining the office.

NATIONAL ENERGY STRATEGY

Mrs. BOGGS. Once the Department has completed the development of the National Energy Strategy how will it be packaged and presented to the public and the Congress? And do you foresee some sort of omnibus energy legislation such as the 1978 Energy Act resulting from the plan?

Ms. STUNTZ. Madam Chairman, we foresee, as I indicated briefly in my testimony, submitting it the end of this year to the President some specific recommendations that would include recommendations for legislation, as well as regulatory recommendations and recommendations even for State initiatives. Depending on what the President chooses to do with those, we would hope that there will be some legislative recommendations forwarded to the Hill by him about a year from now. I don't know at this point whether those would take the form of one package or whether those would be discreet initiatives.

Mrs. BOGGS. I thank you so much, Ms. Stuntz. And I thank you especially for the fine briefing that you participated in a couple of

days ago. We were very much concerned, of course, about the Strategic Petroleum Reserve and various opportunities for filling it.

Ms. STUNTZ. Thank you.

Mrs. BOGGS. It is very nice, Mr. Myers, that we have among the officers here several people who have served on the Hill in various capacities, and it is nice to have them in Congressional liaison and in policy making and in public affairs. It is the very finest panel that has ever appeared before this committee.

Mr. MYERS. It is always nice to see people that have gone on and done well.

Mrs. BOGGS. I was also very interested in the fact that we are really reaching out. Almost every witness from the Energy Department has talked about the environmental impact difficulties, and also the areas where we can see some successes, and so on. Also, there is the emphasis on trade and reaching out internationally.

I wonder, in the environmental field, if we are thinking about not only the global change but also the trade and commerce issues that have developed in the last few months. We now have the opening up of the whole Eastern European bloc and we are recognizing trade and transfer of technology issues that weren't allowed previously. Also the environmental conditions that may be a problem. Have we coordinated any of that?

ENERGY TRADE OPPORTUNITIES

Mr. EASTON. We have, Madam Chair. I am pleased to describe a couple of efforts that my office, in conjunction with other offices in the Department, is undertaking.

One is the Deputy Secretary's whole initiative to expand opportunities for American companies in the energy sector. It comes from his Louisiana background, knowing the capability of the oil and gas service industry and seeing that there are many opportunities around the world for that industry. This has led Henson Moore to ask us to work hard to explore and identify opportunities for all companies in the American energy sector around the world.

That is coupled with a second program that has been underway at the Department and is receiving increased attention now from my principal deputy, Arlen Erdahl, a former member of this distinguished body. Arlen will take this as his personal responsibility and will draw upon not only his Congressional background, but also his Peace Corps background. Arlen will be leading the Department's efforts in dealing with both the Third World, and the developing countries to promote some of the technology that is environmentally sensitive and useful to those countries.

One of the ways we will get a handle on such issues as global climate concerns is if we can take technologies that enable some of the developing countries in the world to enjoy a better standard of living, perhaps without having to turn to the traditional sources that we have always used in this country and take some of those creative technologies to provide fuel and energy for cooking, for example. So that will be a task we will be undertaking in our office led by Mr. Erdahl.

Mrs. BOGGS. I was very interested in the fact that you coordinate many of the international programs. I was wondering if you have

been involved in the fact that 1991 is the year of the exploration of the Antarctica Treaty. Of course, we have a minerals regime suggestion. Is the Department of Energy involved in these negotiations?

Mr. EASTON. Curiously, we have some—I think both in my office as well as in Linda Stuntz's office. We have people that have been involved in Antarctica issues in the past. Since we have great capability within the office and within the Department of Energy and will be working—our two offices work fairly closely, because of the international aspect and the policy aspect—to take our qualified personnel that have had experience in these areas, and work to have them represent us fully so that the Department's views are made known and are taken into account.

Mrs. BOGGS. Also, in that situation you would have to integrate your environmental concerns.

Mr. EASTON. Absolutely.

OUTER CONTINENTAL SHELF RESOURCES

Mrs. BOGGS. The Department has a key role to play in President Bush's review of the leasing of the Outer Continental Shelf and the resources there. What can we expect out of this review, and when will this recommendation be presented to the President?

Ms. STUNTZ. Madam Chairman, we did participate in the OCS Task Force activities. A representative from my office, as well as a representative from the Office of Fossil Energy, went to the workshops and participated in the drafting of the report. There was—and I think it is generally known—there was presented to the President in that report a number of options as to how the three lease/sales at issue in that particular task force report should be dealt with.

There was a meeting between the President and the Deputy Secretary, as well as other principals involved in that, in December, I believe.

The President, who probably knows more about this from personal experience than most other sitting presidents—even some of the particular areas. When he was at Zapata he was involved in these—has asked for additional information. He wasn't entirely satisfied. I think that the Task Force had given him all the options that might be appropriate to consider.

My understanding is that a formal Cabinet decision memo has been virtually completed and that he is expected to make a decision over the next couple of weeks, but I don't have any particular insight as to what that decision will be.

Mrs. BOGGS. Thank you very much.

I was thinking, as we listened to Mr. Myers' difficulties that he experienced in Florida with the rolling blackouts or the brownouts that it really is sad that so many of the delays that you spoke about, Mr. Easton, were caused by transportation difficulties.

Most of the oil spills or those sorts of environmental hazards and tie-ups and loss are caused in transportation accidents. And yet we have the resistance of the people of Florida and some of the other States in being able to develop the Outer Continental Shelf where

there has never been an oil spill of anything like the proportions of those that are caused by transportation.

Of course, much of the oil from the rest of the world comes around the Keys and right into the Gulf. I'm just sorry they denied you, John, the kind of energy that you could have had for a pleasant Christmas vacation.

We are very grateful to all of you for what you are doing. We are very happy to have you aboard. Thank you very much.

Mr. Myers?

Mr. MYERS. Did you ever try cold turkey?

Mrs. BOGGS. What?

Mr. MYERS. Uncooked turkey.

Thank you, Madam Chair.

I do have a series of questions. I'll ask several of you to put them in the record because you have been here a long time.

But I do have one, Mr. Wakefield. You come from Olney. How old were you when you left Olney?

Mr. WAKEFIELD. Approximately two weeks, Mr. Myers.

Mr. MYERS. Okay. [Laughter.]

Olney is a town in Southern Illinois—coal and oil area, at one time. But they are noted for white squirrels. The squirrels they have there are white. They are not gray, they are white. I used to visit Olney. I dated a girl down there when I was at the University of Illinois. It is a long drive down there.

Mr. WAKEFIELD. I have heard of those white squirrels, but I don't believe I have ever seen them. I think some of our plants may have similar animals around them.

Mr. MYERS. Well, of course, Argonne has the white deer.

YUCCA MOUNTAIN

Well, I have one question about Yucca Mountain. What is the status of any litigation that may be pending? How actively are you involved in the Yucca Mountain facility?

Mr. WAKEFIELD. Very active. We have filed suit against the State of Nevada in the District Court in Nevada seeking to compel the State to act upon permit applications that we have filed that are necessary before we can proceed with site characterization.

There is also litigation in the 9th Circuit on the same issues. That litigation, which was originally brought under a special provision of the law by the State, is moving on a fast track. I think briefing is due to be concluded in May or June in that case. So that is moving pretty rapidly. We hope the district court litigation will move rapidly, as well.

We would like to get those permits, but, as you may know, the State has declined even to act upon them under what we consider to be not properly asserted legal grounds.

Mr. MYERS. Are there any injunctions which are prohibiting activities out there as far as progress?

Mr. WAKEFIELD. They have sought injunctions and, in fact, I believe are seeking it in the 9th Circuit.

Mr. MYERS. They? The State of Nevada?

Mr. WAKEFIELD. The State of Nevada. Yes. They are seeking it in the 9th Circuit case. But as of this time there are none that would

preclude it, but it is basically air permits that are needed for us to do certain activities on the site. They are preventing us from doing all the work we need to do. I believe there is some ongoing work, but the real work that needs to be done to characterize the site is going to require——

Mr. MYERS. Are the test borings—pardon me for interrupting you. The test borings are proceeding without any interruption?

Mr. WAKEFIELD. I don't believe so. Certainly the major shaft——

Mr. MYERS. That wouldn't have anything to do with air, would it?

Mr. WAKEFIELD. I'm sorry.

Mr. MYERS. What permits are needed to do the test borings?

Mr. WAKEFIELD. I think some of them do require Clean Air permits in order to proceed.

Mr. MYERS. To drill holes in the ground you have got to have Clean Air?

Mr. WAKEFIELD. I believe that is correct.

Mr. MYERS. We have gone a long ways, haven't we?

Mr. WAKEFIELD. Yes.

Mr. LAYTON. The State has to approve our drilling through permits. The Federal Government prepares the impact statements, and the State hasn't acted to allow us to proceed with the drilling. That is the way I understand it.

Mr. MYERS. Is there any legislation required from the Federal point of view? Do we need additional legislation?

Mr. WAKEFIELD. It may be possible, if we either don't get the correct answer in the litigation or if the litigation is just taking too long. We may have to be back to Congress to ask for legislation, but at this time we are trying to pursue the judicial course and hopefully get some cooperation from the State, which has not been forthcoming.

Mr. MYERS. As you are aware, this subcommittee, of course, does not have direct legislative authority. We are Members of Congress and this committee is very concerned about proceeding on Yucca Mountain because we just simply have to have a repository some place as soon as possible.

Mr. WAKEFIELD. Yes.

Mr. MYERS. We have known that for some time, and somehow we don't make progress very fast.

Mr. WAKEFIELD. We seem to be going in the opposite direction.

Mr. MYERS. It is like a dance step—sidestep and backstep and not many forward.

Mr. WAKEFIELD. Well, I think we have a good program now that Admiral Watkins has scrubbed so that we can talk about realistic mileposts and time deadlines, as opposed to perhaps some of the programs in the past that may have been overly optimistic.

Mr. MYERS. Thank you.

In my opening statement I made the comment that you are the people that do the work, and I meant that sincerely. I didn't mean that facetiously. You are the people that carry out administratively the responsibilities of the Department. It is a tremendous responsibility. While our nation doesn't have an energy policy, per se, you are the people that would implement one. You are establishing a policy which would be considered to be an energy policy.

Our country certainly needs direction, as has been discussing this morning. We have discussed the brownouts or blackouts. While that might be a personal inconvenience, it is a national inconvenience. I am concerned that those who have the responsibility of providing, as a utility, the energy to keep the wheels of industry moving and keep our economy moving are not fulfilling their responsibility. Something should be done. Either they should lose their right to operate as a utility in an atmosphere of a monopoly. With that they have to make some tradeoffs. I am concerned.

I know there are problems with utilities. They have environmental problems and permit problems, as you are experiencing. But—if they are not utilizing the facilities they presently have, for whatever reason, I think something ought to be done. That's what I am concerned about. Are they really utilizing the facilities they have available to them?

Thank you for the work you are doing and for your testimony this morning.

Mrs. BOGGS. I thank all of you very, very much.

I know that you have a mandate from the Secretary in his reorganization plan. We all have tremendous respect for him. Certainly we have the highest respect for our former colleague, Henson Moore.

In addition, of course, I would like to say that in the environmental field I am happy to know that you are sensitive to the wetlands issue because, of course, we are losing so many of our wetlands in Louisiana.

We are very grateful to all of you. We have several questions that other colleagues have submitted that we will submit for the record.

This committee will stand adjourned until 1:00 p.m. on Monday.

Thank you.

REPROGRAMMING PROCEDURES

Mr. Bevill. The Department has its reprogramming rules published in DOE Order 5160.A. These rules have been coordinated with this Committee. I would like your personal commitment that the Department will abide by those reprogramming rules.

Mr. Tarro. As Admiral Watkins has stated, the Department is fully aware of the interest Congress has in the execution of our programs, and I am committed to keeping Congress fully informed of any proposed changes. In the last several weeks the Department has provided the Committee with a number of reprogramming notifications, and I can assure you that we will take no action without full consideration of the Committee's views. The procedures outlined in DOE Order 5160.A are being revised to reflect the fact that the Secretary wants to approve and sign each proposed reprogramming to ensure that only the most necessary redirections of appropriated funds are submitted.

APPROPRIATION LANGUAGE CHANGE

Mr. Bevill. Please explain the rationale for changing the appropriation language for Departmental Administration.

Mr. Tarro. The Administration proposes to change the appropriation language to provide a net appropriation to the Department and such net appropriation is used for calculating the impact on the GRH targets. If a gross appropriation was requested to be offset by estimated revenues, the Administration would score the entire gross appropriation against the GRH target since the estimated revenues may not occur.

USE OF PRIOR YEAR BALANCES

Mr. Bevill. Please describe your use of prior year balances and other adjustments to finance the Departmental Administration appropriation.

Mr. Tarro. The Department tries to formulate its budget so no unobligated balances remain at year-end, but as the budget is executed events frequently occur which result in unobligated balances remaining at the end of the fiscal year. These estimates are especially difficult to predict since actual obligations for the Cost of Work for Others program are dependent upon the decisions by outside customers. When unobligated balances occur they are used to offset our need for future budget authority. The FY 1991 budget request is offset by $16.4 million of unobligated balances from FY 1989. This is a significant decrease from the $44.4 million and $33.1 million of unobligated balances used to offset the FY 1989 and FY 1990 appropriations, respectively.

FY 1990 REPROGRAMMINGS

Mr. Bevill. Please provide a list of reprogramming requests that are anticipated in FY 1991.

Mr. Tarro. At this point it is too early to anticipate reprogramming requests for FY 1991. However, there are several FY 1990 reprogrammings which are detailed below:

$3.5 million will be reprogrammed from Departmental Administration unobligated balances to Management and Administration to fund the construction of two child care centers.

$1.8 million will be reprogrammed from Departmental Administration unobligated balances to Management and Administration to fund relocation expenses for 300 employees in the Forrestal Building who will have to work in a leased location while the Plaza Deck is being rebuilt. The employees will return to the Forrestal Building in mid-1992.

A proposed Economic Regulatory Administration (ERA) reprogramming would transfer responsibility for collection of oil overcharge receivables from ERA to the Controller.

COST OF WORK INCREASE

Mr. Bevill. Please explain the significant increase in "Cost of Work for Others" in FY 1991.

Mr. Tarro. The overall increase in the Cost of Work program is $33.2 million. The predominant components of this increase are the following: The major Cost of Work increase is $25.0 million for the purchase of General Purpose Equipment used in support of Other Federal Agencies at the Department's National Labs. Previously other federal agencies were charged for the procurement of general purpose capital equipment through the reimbursable account. A review of this procedure indicated that this practice was not appropriate because it resulted in the full cost of the capital equipment being charged to the other federal agency in a single year, rather than being spread over the useful life of the equipment. As a result, in order to avoid establishing a complicated procedure of charging for the consumption of the equipment annually, it was decided to budget for the procurement of the equipment in the Cost of Work program. The other Federal Agencies will then pay for this equipment and these receipts will increase our revenues associated with the Cost of Work program by the same amount. Also, there are miscellaneous increases throughout the Cost of Work Operations Offices of $8.2 million.

OPERATIONS OFFICES BUDGET

Mr. Bevill. Please provide a breakdown of salaries and contractual support for each operations office in FY 1989, FY 1990 and FY 1991.

Mr. Tarro. A table displaying the breakdown of the operations offices funding is provided for the record.

Operations Offices 1/
($ 000's)

	FY 1989	FY 1990	FY 1991
Chicago			
Salary expenses.....	$ 18,104	$ 18,062	$ 15,761
Contractual support..	6,437	6,694	6,889
Capital equipment....	174	181	186
Total.....	$ 24,715	$ 24,937	$ 22,836
Idaho			
Salary expenses.....	$ 11,837	$ 11,373	$ 10,712
Contractual support..	5,281	5,492	5,652
Capital equipment....	297	309	318
Total.....	$ 17,415	$ 17,174	$ 16,682
Oak Ridge			
Salary expenses.....	$ 23,839	$ 22,523	$ 22,885
Contractual support..	9,064	9,402	9,744
Capital equipment....	426	442	456
Total.....	$ 33,329	$ 32,367	$ 33,085
Richland			
Salary expenses.....	$ 14,715	$ 12,775	$ 13,906
Contractual support..	4,408	4,584	4,717
Capital equipment....	155	161	166
Total.....	$ 19,278	$ 17,520	$ 18,789
San Francisco			
Salary expenses.....	$ 13,031	$ 12,230	$ 11,796
Contractual support..	5,728	5,957	6,130
Capital equipment....	66	69	71
Total.....	$ 18,825	$ 18,256	$ 17,997
Total			
Salary expenses.....	$ 81,526	$ 76,963	$ 75,060
Contractual support..	30,918	32,129	33,132
Capital equipment....	1,118	1,162	1,197
Total.....	$113,562	$110,254	$109,389

1/ Budgets of the Operations Offices reflect a transfer of 154 FTEs to Defense Programs and 91 FTEs to Environmental Restoration and Waste Management.

EMPLOYMENT ESTIMATES

Mr. Bevill. Provide for the record a table showing current and yearend planned personnel strengths for each organizational entity in the Department, including the operations offices, each laboratory and other GOCO activity.

Mr. Tarro. Tables showing current and yearend estimated employment are provided for the record.

(The information follows:)

DEPARTMENT OF ENERGY FY 1990 EMPLOYMENT

ORGANIZATION	TOTAL EMPLOYMENT MARCH 10, 1990	ESTIMATED EMPLOYMENT SEPT 30, 1990
Office Of The Secretary	55	55
Administration, Controller & Procurement	1,256	1,230
General Counsel	159	162
Inspector General	229	240
Congressional & Intergovernmental Affairs	85	80
Hearings & Appeals	83	89
Int'l Affairs & Energy Emergencies	148	145
Board Of Contract Appeals	8	8
Office Of Minority Economic Impact	12	11
Office Of Civilian Radioactive Waste	206	210
Policy, Planning & Analysis	77	90
Environment, Safety & Health	249	245
Office of New Production Reactors	84	105
Office of Public Affairs	32	32
Office of Nuclear Safety	7	40
Environmental Restoration & Waste Management	73	150
Conservation & Renewable Energy	314	310
Office Of Energy Research	307	350
Defense Programs	491	550
Nuclear Energy	260	275
Fossil Energy	258	250
Economic Regulatory Administration	102	100
Energy Information Administration	473	470
Federal Energy Regulatory Commission	1,482	1,500
Headquarters Subtotal	6,450	6,697
Albuquerque Operations Office	1,386	1,380
Chicago Operations Office	591	590
Richland Operations Office	350	350
Idaho Operations Office	398	395
Oak Ridge Operations Office	682	700
San Francisco Operations Office	302	312
Savannah River Operations Office	365	375
Nevada Operations Office	315	320
Operations Offices Subtotal	4,389	4,422
Southeastern Power Administration	39	40
Southwestern Power Administration	182	184
Alaska Power Administration	32	35
Bonneville Power Administration	3,330	3,320
Western Area Power Administration	1,399	1,380
Power Administrations Subtotal	4,982	4,959

DEPARTMENT OF ENERGY FY 1990 EMPLOYMENT

ORGANIZATION	TOTAL EMPLOYMENT MARCH 10, 1990	ESTIMATED EMPLOYMENT SEPT 30, 1990
Office of Scientific & Technical Info	168	175
Pittsburgh Naval Reactors Office	79	79
Schenectady Naval Reactors Office	65	70
Rocky Flats Office	81	92
Savannah River Restart Project Office	57	65
Naval Petroleum Reserve - Casper	12	13
Naval Petroleum Reserve - Elk Hills	55	58
Special Purpose Offices Subtotal	517	552
Bartlesville Project Office	15	15
Morgantown Energy Technology Center	281	290
Pittsburgh Energy Technology Center	292	305
Energy Technology Centers Subtotal	588	610
TOTAL	16,926	17,240

DEPARTMENT OF ENERGY - CONTRACTOR MANPOWER

DOE OFFICES CONTRACTOR	OPERATION	LOCATION	ST	9/30/89 ONBOARD
ALBUQUERQUE OPERATIONS OFFICE				
ALLIED CORPORATION	KANSAS CITY DIV	KANSAS CITY	MO	6,829
GENERAL ELECTRIC CO	PINELLAS PLANT	CLEARWATER	FL	1,698
LOVELACE MED FDN	BIO & ENVIR RES INSTITUTE	ALBUQUERQUE	NM	199
MASON & HANGER-SILAS	PANTEX PLANT	AMARILLO	TX	2,373
MONSANTO RESEARCH	MOUND LABORATORY	MIAMISBURG	OH	2,130
ROCKWELL INTERNATIONAL	ROCKY FLATS PLANT	GOLDEN	CO	5,312
ROSS AVIATION, INC		ALBUQUERQUE	NM	172
SANDIA CORPORATION	SANDIA NATL LAB	ALBUQUERQUE	NM	7,382
SANDIA CORPORATION	SANDIA NATL LAB	LIVERMORE	CA	1,050
UNIV OF CALIFORNIA	LOS ALAMOS NATL LAB	LOS ALAMOS	NM	7,667
WESTINGHOUSE ELEC CORP	WASTE ISOLATION PILOT PROJ	CARLSBAD	NM	506
FIELD OFFICE TOTAL				35,538
CHICAGO OPERATIONS OFFICE				
ASSOCIATED UNIVERSITIES	BROOKHAVEN NATL LAB	UPTON, L.I.	NY	3,415
IOWA STATE UNIVERSITY	AMES RESEARCH LAB	AMES	IA	479
MIDWEST RESEARCH INST	SOLAR ENERGY RES INST	GOLDEN	CO	403
PRINCETON UNIVERSITY	PRINCETON PLASMA PHYS LAB	PRINCETON	NJ	849
UNIV OF CHICAGO	ARGONNE NATL LAB	ARGONNE	IL	2,884
UNIV OF CHICAGO	ANL REACTOR FACILITIES	IDAHO FALLS	ID	713
UNIV RESEARCH ASSN	FERMI LAB	BATAVIA	IL	2,182
FIELD OFFICE TOTAL				10,925
IDAHO OPERATIONS OFFICE				
EG&G, INC	IDAHO NATIONAL ENG LAB	IDAHO FALLS	ID	4,191
MK FERGUSON ID CO	CONST MGMT INEL	IDAHO FALLS	ID	84
MSE INC	MERDI	BUTTE	MT	193
PRO TECH IDAHO INC	PTI INEL SECURITY	IDAHO FALLS	ID	374
ROCKWELL INTERNATIONAL	SMC PROJECT INEL	IDAHO FALLS	MT	451
UNC GEOTECH	UNC TECH SERVICE CO	GRAND JUNCTION	CO	569
WESTINGHOUSE ELEC CO	WEST VALLEY NUC SVS CO.	WEST VALLEY	NY	543
WESTINGHOUSE ID NUC	IDAHO NATL ENGRG LAB	IDAHO FALLS	ID	1,460
FIELD OFFICE TOTAL				7,865
NAVAL PETROLEUM RESERVE				
BECHTEL	NAVAL PETRO RESERVE CA	ELK HILLS	CA	707
JOHN BROWN	FORMERLY LAWR ALLISON	CASPER	WY	129
FIELD OFFICE TOTAL				836

DEPARTMENT OF ENERGY - CONTRACTOR MANPOWER

DOE OFFICES

CONTRACTOR	OPERATION	LOCATION	ST	9/30/89 ONBOARD
NEVADA OPERATIONS OFFICE				
E&G, INC	KIRTLAND OPERATIONS	ALBUQUERQUE	NM	273
E&G, INC	LAS VEGAS AREA OPNS	LAS VEGAS	NV	1,558
E&G, INC	AMADOR VALLEY OPNS	SAN RAMON	CA	187
E&G, INC	SANTA BARBARA OPNS	SANTA BARBARA	CA	128
E&G, INC	LOS ALAMOS OPNS	LOS ALAMOS	NM	132
E&G, INC	WOBURN OPNS	WOBURN	MA	29
E&G, INC	GOLETA VALLEY OPNS	SANTA BARBARA		46
FENIX & SCISSON, INC	A-E DRILLING & MINING	LAS VEGAS	NV	184
HOLMES & NARVER, INC	PACIFIC TEST DIV	HONOLULU	HI	490
HOLMES & NARVER, INC	ENERGY SUPPORT DIV	LAS VEGAS	NV	618
REYNOLDS ELEC ENGRG	SUPPORT SERVICES	LAS VEGAS	NV	5,206
WACKENHUT SVS, INC	SECURITY GUARD SVS	LAS VEGAS	NV	428
FIELD OFFICE TOTAL				9,281
OAK RIDGE OPERATIONS OFFICE				
BOEING PETROLEUM SVS, INC	STRATEGIC PETROL RES OFFICE	NEW ORLEANS	LA	1,138
MARTIN MARIETTA	Y-12 PLANT	OAK RIDGE	TN	6,904
MARTIN MARIETTA	OAK RIDGE NUC DIV GAS	OAK RIDGE	TN	2,986
MARTIN MARIETTA	PADUCAH NUC DIV	PADUCAH	KY	1,362
MARTIN MARIETTA	PORTSMOUTH GAS DIF PLANT	PIKETON	OH	2,288
MARTIN MARETTA	OAK RIDGE NATL LAB	OAK RIDGE	TN	3,418
OAK RIDGE ASSOC UNIV	RESEARCH AND OTHER	OAK RIDGE	TN	499
RUST ENGINEERING CO		OAK RIDGE	TN	158
WESTINGHOUSE ELEC CORP.	WASTE MATERIALS CO OF OHIO	FERNALD	OH	1,122
FIELD OFFICE TOTAL				21,875
PITTSBURGH NAVAL REACTORS OFC				
WESTINGHOUSE	BETTIS ATOMIC POWER	PITTSBURGH	PA	2,568
WESTINGHOUSE	NAVAL REACTOR FAC	IDAHO FALLS	ID	1,033
FIELD OFFICE TOTAL				3,601

DEPARTMENT OF ENERGY - CONTRACTOR MANPOWER

DOE OFFICES CONTRACTOR	OPERATION	LOCATION	ST	9/30/89 ONBOARD
RICHLAND OPERATIONS OFFICE				
BATTELLE	PACIFIC NORTHWEST LAB	RICHLAND	WA	2,610
BCS RICHLAND, INC		RICHLAND	WA	822
HANFORD HEALTH FDN		RICHLAND	WA	122
KAISER ENGRG HANFORD		RICHLAND	WA	980
WESTINGHOUSE HANFORD	CONSOLIDATED	RICHLAND	WA	7,527
FIELD OFFICE TOTAL				12,061
SAN FRANCISCO OPERATIONS OFFICE				
ROCKWELL INTERNATIONAL	ETEC	CANOGA PARK	CA	147
STANFORD UNIVERSITY	LINEAR ACCELERATOR CTR	STANFORD	CA	1,198
UNIV OF CALIFORNIA	LAW BERKELEY NATL LAB	BERKELEY	CA	2,436
UNIV OF CALIFORNIA	LAW LIVERMORE NATL LAB	LIVERMORE	CA	7,670
UNIV OF CALIFORNIA	LAW LIVERMORE NATL LAB	MERCURY	NV	89
UNIV OF CALIFORNIA	LAW LIVERMORE NATL LAB	SITE 300	CA	283
FIELD OFFICE TOTAL				11,823
SAVANNAH RIVER OPERATIONS OFFICE				
BECHTEL	SR SITE ENGRG & CONSTRUCTION	AIKEN	SC	2,682
UNIV OF GEORGIA	SAVANNAH RIVER ECOLOGY LAB	AIKEN	SC	142
WACKENHUT SVS, INC	SAVANNAH RIVER SECURITY SVS	AIKEN	SC	974
WESTINGHOUSE	SAVANNAH RIVER SITE	AIKEN	SC	11242
FIELD OFFICE TOTAL				15,040
SCHENECTADY NAVAL REACTORS OFC				
GENERAL ELECTRIC CO	KNOLLS ATOMIC PWR LAB	SCHENECTADY	NY	3,145
GENERAL ELECTRIC CO	KNOLLS ATOMIC PWR LAB	WINDSOR	CT	175
FIELD OFFICE TOTAL				3,320
	GRAND TOTAL			132,165

No detailed projection of end of year FY 1990 contractor employment has been made. Overall, it is estimated that this employment figure will vary from the end of FY 1989 level by +/- 1.5%.

FOREIGN TRAVEL BY DEPARTMENT OF ENERGY EMPLOYEES AND CONTRACTORS

Mr. Bevill. How much was spent on foreign travel within the Department, including laboratories, in FY 1989, planned in FY 1990 and FY 1991?

Mr. Easton. An estimate of expenditure levels will be provided to the Committee as soon as it is available.

ADVISORY COMMITTEES

Mr. Bevill. Provide a list of advisory committees, a description of each, a list of reports or other advice given to the Department, and the amount budgeted for each in FY 1989, FY 1990, and FY 1991.

Mr. Tarro. The Department currently has 16 chartered committees. During Fiscal Year 1989, the charter for the Innovative Control Technology Advisory Panel (ICTAP) expired in April 1989, and the charter for the statutory Technical Panel on Magnetic Fusion (TPMF) of the Energy Research Advisory Board expired in June 1989. The Department is currently planning to reestablish the TPMF. A description of each committee, a list of the FY 1989 and FY 1990 reports received by the Department, and the actual expenditures for FY 1989 and the estimated budgets for FY 1990 and FY 1991, are shown in tables that I would like to insert into the record.

(The information follows:)

DEPARTMENT OF ENERGY ADVISORY COMMITTEES

Advisory Committee on Nuclear Facility Safety

The Advisory Committee on Nuclear Facility Safety (ACNFS) was established on November 13, 1987. The ACNFS was established to provide to the Secretary of Energy technical information, advice, and recommendations concerning the safety of the Department of Energy's (DOE) production and utilization facilities, as defined in section 11 of the Atomic Energy Act of 1954, as amended (42 U.S.C. 2014), except those facilities and operations covered under Executive Order 12344 (42 U.S.C. 7158, note). A review of other nuclear related facilities or operations may be conducted if directed by the Secretary, except those facilities and operations covered under Executive Order 12344.

American Statistical Association Committee on Energy Statistics

The American Statistical Association Committee on Energy Statistics (ASA) was established by the ASA at the request of the Secretary of Energy on October 17, 1984. This Committee was established to utilize the expertise of the ASA for review of elements of Energy Information Administration (EIA) information collection and analysis programs; advice on priorities of technical and methodological issues in the planning, operation and review of EIA statistical programs; and advice on matters concerning improved energy modeling and forecasting tools, particularly regarding their functioning, relevancy and results.

Basic Energy Sciences Advisory Committee

The Basic Energy Sciences Advisory Committee (BESAC) was established on October 16, 1986. The BESAC was established to provide advice to the Secretary of Energy through the Director of Energy Research on elements of the Department's Basic Energy Sciences (BES) Program including advice on long-range plans, priorities, and strategies to address more effectively the scientific aspects of energy-related basic energy sciences issues of Departmental policies and programs. The Committee will provide recommendations, as requested, on appropriate levels of funding to develop those plans, priorities and strategies and to help maintain aporopriate balance between competing elements of the BES program, and on scientific aspects of basic energy sciences issues of concern to DOE.

DOE/NSF Nuclear Science Advisory Committee

The DOE/NSF Nuclear Science Advisory Committee (NSAC) was established on September 23, 1977. The NSAC provides advice upon request to both the Department of Energy (DOE) and the National Science Foundation (NSF) on scientific priorities within the field of basic nuclear science research. Basic nuclear research is understood to encompass experimental and theoretical investigations of the fundamental interactions, properties, and structures of atomic nuclei. NSAC activities will include assessment of and recommendations concerning: a) objectives, directions and development and future frontiers of the field of basic nuclear science; b) adequacy of present facilities, and the need and relative priority for new facilities;

c) facility and instrument development programs needed to advance the field; d) institutional balance of support for optimized scientific productivity and training of nuclear scientists; and e) relationships of basic nuclear science with other fields of science.

Energy Research Advisory Board

The Energy Research Advisory Board (ERAB) was established on June 19, 1978. to advise the Secretary, the Director of Energy Research, and other Departmental officials, as requested, on the research and development activities of DOE and to provide expert guidance in these areas to the Department.

Fusion Policy Advisory Committee

The Fusion Policy Advisory Committee (FPAC) was established on November 20, 1989. The FPAC will, on a one-time basis, review the new draft fusion policy covering both magnetic and inertial confinement, and provide its recommendation for a fusion policy for the Department of Energy. The review will focus on the technical basis for, and the likely effectiveness of, the policy proposed. The final written report will provide advice on how to structure the fusion programs -- either by the proposed policy, some specific modifications to it, or some totally different approach.

Health and Environmental Research Advisory Committee

The Health and Environmental Research Advisory Committee (HERAC) was established on Novemher 22, 1983. The HERAC was established to conduct periodic reviews of elements of the Health and Environmental Research Program and provide advice on long-range plans, priorities, and strategies to address more effectively the scientific aspects of energy-related health and environmental issues of Departmental policies and programs. Advice would also be sought on appropriate levels of funding to develop those plans, priorities, and strategies, and to help maintain appropriate balance between competing elements of the program.

High Energy Physics Advisory Panel

The High Energy Physics Advisory Panel (HEPAP) was established on January 27, 1967. The HEPAP was established to provide advice and guidance on a continuing basis to the Secretary of Energy, through the Director of Energy Research, on the national high energy physics research program, including: a) periodic reviews of the program and recommendation of any changes considered desirable on the basis of scientific and technological advances or other factors; b) advice on long-range plans, priorities, and strategies for the national high energy physics program; c) advice on recommended appropriate levels of funding to assure a world leadership position, and to help maintain appropriate balance between competing elements of the program; and d) advice and guidance on any issues relating to the program as requested by the Secretary or the Director of Energy Research.

Laboratory Evaluation Committee

The Laboratory Evaluation Committee (LEC) was established on February 22, 1989 as a pilot project to determine the feasibility of establishing external oversight committees for each Energy Research multi-program laboratory. The committee will conduct evaluations of the Oak Ridge National Laboratory (ORNL) scientific programs on a pilot basis. The Secretary of Energy will be provided, through the Director of Energy Research, technical information, advice, and recommendations concerning the quality of science, productivity of personnel, and relevance to national needs of the scientific work at ORNL. Programs to be reviewed include all scientific advanced R&D, and applied R&D effort underway at the laboratory. Special evaluations of a specific area of scientific or R&D activity will be conducted by the Committee when requested by the Secretary or the Director of Energy Research.

Magnetic Fusion Advisory Committee

The Magnetic Fusion Advisory Committee (MFAC) was established on May 25, 1982 to provide advice and recommendations on a continuing basis to the Secretary of Energy, through the Director of Energy Research, on the magnetic fusion energy program including: a) periodic reviews of elements of the program and recommendation of any changes considered desirable on the basis of scientific and technological advances or other factors; b) advice on long range plans, priorities, and strategies to demonstrate the scientific and engineering feasibility of fusion; c) advice on recommended appropriate levels of funding to develop those strategies and to help maintain appropriate balance between competing elements of the program; and d) advice and guidance on any issues relating to the program as requested by the Secretary or the Director of Energy Research.

National Coal Council

The National Coal Council (NCC) was established on November 21, 1984 to provide advice and recommendations on a continuing basis as requested by the Secretary of Energy on general policy matters relating to coal, including: a) Federal policies which affect, directly or indirectly the production, marketing, and use of coal; b) plans, priorities, and strategies to address more effectively the technological, regulatory, and social impact issues relating to coal production and use; c) appropriate balance between various elements of federal coal-related programs; d) scientific and engineering aspects of coal technologies, including emerging coal conversion, utilization, or environmental control concepts; and e) the progress of coal research and development, pursuant to the Office of Coal Research Act, Public Law 86-599.

National Energy Extension Service Advisory Board

The National Energy Extension Service Advisory Board (NEESAB) was established by the National Energy Extension Service Act, Public Law 95-39, Section 509 and was chartered on June 14, 1980. The NEESAB was established to carry on a continuing review of the comprehensive Energy Extension Service Program and approved plans of the Governors of each State for

implementing Energy Extension Service activities. The purpose of this review is to advise the Director of Energy Extension Service, the Secretary of Energy, and the Congress on the effectiveness of this program and the plans in achieving the objectives of the National Energy Extension Service Act (Public Law 95-39) and to determine how their operation might be improved in furtherance of such objectives.

National Petroleum Council

The National Petroleum Council (NPC) was established by the Secretary of Interior on May 3, 1946, at the request of President Harry S. Truman. The NPC was transferred to the Department of Energy after DOE's formal establishment on October 1, 1977. The NPC was established to continue government-industry cooperation which had begun during World War II and currently provides the Secretary of Energy with advice, information, and recommendations on matters relating to oil and gas or the oil and gas industry.

Secretarial Panel for the Evaluation of Epidemiologic Research Activities of the Department of Energy

The Secretarial Panel for the Evaluation of Epidemiologic Research Activities of the Department of Energy (SPEERA) was established on August 1, 1989. The SPEERA was established to provide to the Secretary of Energy an independent evaluation of the Department of Energy's (DOE) epidemiology program and the appropriateness, effectiveness, and overall quality of DOE's epidemiologic research activities. The SPEERA is responsible for examining the following aspects of DOE's research activities and recommending measures that will ensure that these activities are appropriate, effective, and represent excellence: a) the goals and objectives of the Program; b) the management and reporting structure of the Program: c) the full-time equivalents (FTE's) and budget resources allocated to the Program; (d) the use of contract scientists for ongoing and special projects; e) the quality control mechanisms in the Program; f) the utility and feasibility of transferring the epidemiologic research function; g) maintenance and access to related records such as exposure incident files, materials standards records, and facilities design information belonging to DOE or its contractors; h) current and proposed mechanisms for determining epidemiologic data release policies; i) current and proposed mechanisms for the storage of DOE data; and, j) DOE's response to the data related request of the Three Mile Island Public Health Fund.

Secretary of Energy Advisory Board

The Secretary of Energy Advisory Board (SEAB) was established on January 2, 1990. The SEAB was established to advise the Secretary of Energy on the research, development, energy, and national defense responsibilities, activities, and operations of the Department of Energy (DOE) and to provide expert guidance in these areas to the DOE.

United States Alternative Fuels Council

The United States Alternative Fuels Council (USAFC) was established on March 1, 1990. The USAFC provides advice on a continuing basis, to the

Interagency Commission on Alternative Motor Fuels, on the Commission's efforts to ensure development of a long-term plan for the commercialization of alcohols, natural gas, and other potential alternative motor fuels. The Council's activities include periodic review of alternative fuel activities conducted by the Commission member agencies and recommendation of any changes considered desirable to ensure attention to all critical issues and avoidance of undesired duplication; advice on major technical, economic, and behavioral issues affecting the commercialization of alternative fuels; advice on potential alternative fuels, other than alcohols and natural gas, that should be considered; and special studies or advice on any issues relating to the commercial application and consumer acceptability of alternative fuels.

CURRENTLY ACTIVE DOE ADVISORY COMMITTEES - MARCH 1990

COMMITTEE NAME	DATE ESTABLISHED	DATE RENEWED	NEXT RENEWAL	ESTABLISHMENT AUTHORITY	MEMBERS AUTHORIZED	CURRENT MEMBERS
Advisory Committee on Nuclear Facility Safety (ACNFS)	11/13/87	11/13/89	11/13/91	Agency	15	13
American Statistical Association Cmte on Energy Statistics (ASA)	10/17/84	10/04/88	10/04/90	Agency	Approx 19	19
Basic Energy Sciences Advisory Committee (BESAC)	10/16/86	10/11/88	10/11/90	Agency	Approx 19	0
DOE/NSF Nuclear Science Advisory Committee (NSAC)	09/23/77	09/22/89	09/22/91	Agency	16	17
Energy Research Advisory Board (ERAB)	06/19/78	06/20/88	06/20/90	Agency	Approx 25	14
Fusion Policy Advisory Committee (FPAC)	11/20/89		09/30/90 (Expires)	Agency	Approx 15	19
Health and Environmental Research Advisory Committee (HERAC)	11/22/83	11/22/89	11/22/91	Agency	Approx 19	19
High Energy Physics Advisory Panel (HEPAP)	01/27/67	01/27/89	01/27/91	Agency	Approx 15	15
Laboratory Evaluation Committee (LEC)	02/22/89		02/22/91	Agency	12	0
Magnetic Fusion Advisory Committee (MFAC)	05/25/82	05/25/88	05/25/90	Agency	Approx 16	0
National Coal Council (NCC)	11/21/84	11/27/89	11/27/91	Agency	100 to 125	114
National Energy Extension Service Advisory Board (NEESAB)	06/14/80	11/27/89	11/27/91	Statutory	15 to 20	20
National Petroleum Council (NPC)	05/03/46	11/27/89	11/27/91	Presidential Request	Approx 125	123

CURRENTLY ACTIVE DOE ADVISORY COMMITTEES - MARCH 1990

COMMITTEE NAME	DATE ESTABLISHED	DATE RENEWED	NEXT RENEWAL	ESTABLISHMENT AUTHORITY	MEMBERS AUTHORIZED	CURRENT MEMBERS
Secretarial Panel for the Evaluation of Epidemiologic Research Activities of the DOE (SPEERA)	08/01/89		05/31/90 (Expires)	Agency	Approx 7	9
Secretary of Energy Advisory Board (SEAB)	01/02/90		01/02/92	Agency	30	0
United States Alternative Fuels Council (USAFC)	03/01/90		10/14/90	Statutory	20	20

ADVISORY COMMITTEE REPORTS AND OTHER ACTIVITIES FOR FISCAL YEARS 1989 AND 1990

ADVISORY COMMITTEE ON NUCLEAR FACILITY SAFETY

Meetings

Fiscal Year 1989: October 12-13, 1988; December 13, 1988; January 24-25, 1989; March 1-2, 1989; March 30-31, 1989; May 25, 1989; June 29-30, 1989; July 27-28, 1989; September 6-7, 1989.

Fiscal Year 1990: October 11-12, 1989; November 13-14, 1989; December 11-12, 1989; January 25-26, 1990; February 20-21, 1990.

Reports

Fiscal Year 1989:

1. Letter to Secretary Herrington, dated December 6, 1988, RE: P Reactor at Savannah River, High Flux Isotope Reactor at Oak Ridge National Laboratory, draft DOE Safety Policy, and the High Flux Breeder Reactor at Brookhaven National Laboratory.

2. Letter to Secretary Herrington, dated December 14, 1988, RE: Restarting Savannah River reactors.

3. Letter to Secretary Herrington, dated January 13, 1989, RE: Draft DOE Safety Policy.

4. Letter to Secretary Watkins, dated March 24, 1989, RE: Information on ACNFS and a discussion of safety related issues the Secretary might be confronted with during his early months of service.

5. Letter to Secretary Watkins, dated April 12, 1989, from the Chairman of ACNFS, RE: Response to the Secretary's questions concerning the Chairman's thoughts on the role of ACNFS after the Nuclear Safety Board is operating.

6. Letter to Secretary Watkins, dated June 7, 1989, RE: Safety aspects of the High Flux Beam Reactor at the Brookhaven National Laboratory.

7. Letter to Secretary Watkins, dated July 14, 1989, RE: Waste Isolation Pilot Plant, in Carlsbad, New Mexico, and the High Flux Beam Reactor, High Flux Isotope Reactor, and the Advanced Test Reactor Scram.

8. Letter to Secretary Watkins, dated July 28, 1989, RE: Information and view points concerning Secretary of Energy Notice (SEN) 6, of May 1989, discussing reorganization and realignment actions relating to responsibilities for internal oversight of nuclear safety and discussions on ACNFS and the Defense Nuclear Facilities Safety Board (DNFSB).

9. Letter to Secretary Watkins, dated September 28, 1989, RE: Brief information and views on nuclear safety oversight and the new Office of Nuclear Safety.

Fiscal Year 1990:

1. Letter to Secretary Watkins, dated October 25, 1989, RE: Savannah River Site in South Carolina, and the Waste Isolation Pilot Project (WIPP) Plant.

2. Letter to Secretary Watkins, dated November 30, 1989, RE: Issues concerning Rocky Flats plant in Colorado.

3. Letter to Secretary Watkins, dated December 11, 1989, RE: Comprehensive review of the Waste Isolation Pilot Plant Project.

4. Letter to Secretary Watkins, dated December 15, 1989, RE: Review of issues at PANTEX Plant and the report of the Pantex Tritium Operations Review Committee.

5. Letter to Secretary Watkins, dated January 29, 1990, RE: Rocky Flats and the issue concerning designation of authority and responsibility during an emergency.

AMERICAN STATISTICAL ASSOCIATION COMMITTEE ON ENERGY STATISTICS

Meetings

Fiscal Year 1989: October 27-28, 1988 and April 6-7, 1988.

Fiscal Year 1990: November 2-3, 1989; and March 29-30, 1990 (Planned).

Reports

Fiscal Year 1989: None.

Fiscal Year 1990: None.

BASIC ENERGY SCIENCES ADVISORY COMMITTEE

Meetings

Fiscal Year 1989: October 17-18, 1988; April 10, 1989; and July 10-11, 1989.

Fiscal Year 1990: October 19-20, 1989 and November 29, 1989.

Reports

Fiscal Year 1989:

1988 Review of the Basic Energy Sciences Program of the Department of Energy, dated November 1988.

Fiscal Year 1990:

1989 Review of the Basic Energy Sciences Program of the Department of Energy, dated February 1990.

DOE/NSF NUCLEAR SCIENCE ADVISORY COMMITTEE

Meetings

Fiscal Year 1989: January 27-28, 1989; March 5-6, 1989; April 29-30, 1989; June 26-27, 1989; and August 11-12, 1989.

Fiscal Year 1990: October 14-15, 1989.

Reports

Fiscal Year 1989:

1. Report of the 1989 NSAC Instrumentation Subcommittee, dated March 1989.

2. Recommendations on Three Large Detector Proposals, dated June 1989.

3. Recommendations on the KAON Project, dated May 1989.

Fiscal Year 1990:

Report on Nuclei, Nucleons, Quarks, Nuclear Science in the 1990's: A Long Range Plan, dated December 1989.

ENERGY RESEARCH ADVISORY BOARD

Meetings

Fiscal Year 1989: November 10, 1988.

Fiscal Year 1990: October 30-31, 1989 (Subcommittee); November 8-9, 1989; January 8, 1990 (Subcommittee); February 2, 1990 (Subcommittee); and February 13, 1990.

Reports

Fiscal Year 1989: None.

Fiscal Year 1990:

1. Cold Fusion Research, dated November 1989.

2. Accelerator Production of Tritium, dated February 1990.

FUSION POLICY ADVISORY COMMITTEE

Meetings

Fiscal Year 1989: Not established.

Fiscal Year 1990: March 22-23, 1990 (Planned); and April 2-3, 1990 (Planned).

Reports

Fiscal Year 1989: Not established.

Fiscal Year 1990: None.

HEALTH AND ENVIRONMENTAL RESEARCH ADVISORY COMMITTEE

Meetings

Fiscal Year 1989: May 15-16, 1989; and July 24-25, 1989.

Fiscal Year 1990: January 8-9, 1990.

Reports

Fiscal Year 1989:

Review of the Office of Health and Environmental Research Program on Nuclear Medicine, dated August 1989.

Fiscal Year 1990: None.

HIGH ENERGY PHYSICS ADVISORY PANEL

Meetings

Fiscal Year 1989: November 14-15, 1988; February 6-7, 1989; and May 16-17, 1989.

Fiscal Year 1990: October 5-6, 1989; and January 12, 1990.

Reports

Fiscal Year 1989:

1. Report of the HEPAP Subpanel on HEP Gamma Ray and Neutrino Astronomy, dated November 1988.

2. Report of the HEPAP Subpanel on HEP and the SSC Over the Next Decade, dated February 1989.

3. Report of the HEPAP Subpanel on Major Detectors in Non-Accelerator Particle Physics, dated May 1989.

Fiscal Year 1990:

Report of the HEPAP Subpanel on SSC Physics, dated January 1990.

INNOVATIVE CONTROL TECHNOLOGY ADVISORY COMMITTEE (Charter expired April 1989.)

Meetings

Fiscal Year 1989: November 30 to December 1, 1988.

Fiscal Year 1990: None.

Reports

Fiscal Year 1989:

1. Report to Secretary of Energy - Technology Status Review, dated January 1989.

2. Report to Secretary of Energy - Commercialization Incentives, dated January 1989.

3. Report to Secretary of Energy - Concerning Factors to be Considered in the Third Innovative Clean Coal Technologies Program Solicitation, dated April 1989.

LABORATORY EVALUATION COMMITTEE

Meetings

Fiscal Year 1989: None.

Fiscal Year 1990: None.

Reports

Fiscal Year 1989: None.

Fiscal Year 1990: None.

MAGNETIC FUSION ADVISORY COMMITTEE

Meetings

Fiscal Year 1989: December 6-7, 1988; March 6-7, 1988; and June 6-7, 1989.

Fiscal Year 1990: None.

Reports

Fiscal Year 1989:

1. Report on Electron Cyclotron Heating Requirements for the Fusion Program (Panel 21), dated December 1988.

2. Report on Confinement and Machine Physics (Panel 22), dated June 1989.

Fiscal Year 1990: None.

NATIONAL COAL COUNCIL

Meetings

Fiscal Year 1989: October 4, 1988; November 15, 1988 (Subcommittee); November 16, 1988; June 6, 1988 (Subcommittee); and June 7, 1989.

Fiscal Year 1990: November 8, 1989 (Subcommittee); November 9, 1989; and January 9, 1990 (Subcommittee).

Reports

Fiscal Year 1989:

1. Innovative Clean Coal Technology Deployment, dated November 1988.

2. The Use of Coal in the Industrial, Commercial, Residential, and Transportation Sectors, dated December 1988.

Fiscal Year 1990: None.

NATIONAL ENERGY EXTENSION SERVICE ADVISORY BOARD

Meetings

Fiscal Year 1989: November 17, 1988; January 21-22, 1989; and March 7-8, 1989.

Fiscal Year 1990: None.

Reports

Fiscal Year 1989:

Tenth Annual Report to Congress and the Secretary of Energy on the Nationwide Energy Extension Service Program, dated March 1989.

Fiscal Year 1990: None.

NATIONAL PETROLEUM COUNCIL

Meetings

Fiscal Year 1989: October 25-26, 1988 (Subcommittee); November 13, 1988 (Subcommittee); December 12-13, 1988 (Subcommittee); January 12-13, 1989 (Subcommittee); February 21-22, 1989 (Subcommittee); March 10, 1989 (Subcommittee); and April 18, 1989.

Fiscal Year 1990: None.

Reports

Fiscal Year 1989:

Petroleum Storage and Transportation, Volumes 1 through 5, dated April 1989.

Fiscal Year 1990:

None.

SECRETARIAL PANEL FOR THE EVALUATION OF EPIDEMIOLOGIC RESEARCH ACTIVITIES OF THE DEPARTMENT OF ENERGY

Meetings

Fiscal Year 1989: September 12-13, 1989.

Fiscal Year 1990: October 26-27, 1989; November 13-14, 1989; December 28-29, 1989; January 17-18, 1990; February 22-23, 1990; and March 12-13, 1990.

Reports

Fiscal Year 1989: None.

Fiscal Year 1990:

Interim Report to the Secretary of Energy on the Department of Energy's Epidemiology Program, dated November 22, 1989.

SECRETARY OF ENERGY ADVISORY BOARD

Meetings

Fiscal Year 1989: Not established.

Fiscal Year 1990: None.

Reports

Fiscal Year 1989: Not established.

Fiscal Year 1990: None.

TECHNICAL PANEL ON MAGNETIC FUSION OF THE ENERGY RESEARCH ADVISORY BOARD
(Charter expired June 1989; being reestablished.)

Meetings

Fiscal Year 1989: None.

Fiscal Year 1990: None.

Reports

Fiscal Year 1989: None.

Fiscal Year 1990: None.

UNITED STATES ALTERNATIVE FUELS COUNCIL

Meetings

Fiscal Year 1989: Not established.

Fiscal Year 1990: None.

Reports

Fiscal Year 1989: Not established.

Fiscal Year 1990: None.

BUDGET INFORMATION FOR ADVISORY COMMITTEES

	ACTUAL EXPENDITURES (Whole dollars)	ESTIMATED BUDGETS (Whole dollars)	
	FY 1989	FY 1990	FY 1991
Advisory Committee on Nuclear Facility Safety	$1,414,000	$3,000,000	$3,100,000
American Statistical Association Committee on Energy Statistics	65,453	77,884	79,900
Basic Energy Sciences Advisory Committee	125,000	125,000	175,000
DOE/NSF Nuclear Science Advisory Committee	38,500	14,200	15,000
Energy Research Advisory Board (Committee terminates June 1990)	250,000	125,000	-0-
Fusion Policy Advisory Committee (Committee terminates September 1990)	-0-	125,000	-0-
Health and Environmental Research Advisory Committee	57,550	79,500	99,400
High Energy Physics Advisory Panel	83,872	87,150	90,600
Innovative Control Technology Advisory Panel (Charter expired April 1989)	22,677	-0-	-0-
Laboratory Evaluation Committee (Chartered but never activated)	-0-	-0-	-0-
Magnetic Fusion Advisory Committee	24,500	33,000	36,000
National Coal Council	33,500	40,000	40,000
National Energy Extension Service Advisory Board	62,450	100,000	100,000
National Petroleum Council	75,000	55,000	75,000
Secretarial Panel for the Evaluation of Epidemiologic Research Activities of the DOE (Panel terminates in May 1990)	51,500	615,000	-0-
Secretary of Energy Advisory Board	-0-	650,000	1,300,000
Technical Panel on Magnetic Fusion of the Energy Research Advisory Board (Charter expired June 1989; being reestablished)	-0-	10,000	20,000
United States Alternative Fuels Council	-0-	50,000	100,000
Total	$2,304,000	$5,186,734	$5,270,900

COMPARABILITY ADJUSTMENTS

Mr. Bevill. Please provide a table showing the comparability adjustments between the FY 1990 and FY 1991 budgets. Please explain these adjustments.

Mr. Tarro. A table displaying all comparability adjustments between FY 1990 and FY 1991 and containing explanations is provided for the record. (The information follows:)

DEPARTMENT OF ENERGY
FY 1991 Congressional Budget
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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET TABLE
(DOLLARS IN THOUSANDS)

BY APPROPRIATION

A/S CODE	ACCOUNT TITLE	FY 1989 COMPERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	COMP TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 COMPERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
999100	SUMMARY BY APPROPRIATION:												
999115	ENERGY SUPPLY R&D	2.142.226	19.561	2.161.887	-2.775	2.159.112	-310.139	1.848.973	2.215.644	-31.017	2.184.649	-292.562	1.892.087
998612	ENV. RESTORATION AND WASTE MANAGEM	-----	-----	-----	-----	-----	1.657.347	1.657.347	-----	-----	-----	2.210.317	2.210.317
999125	URANIUM SUPPLY AND ENRICHMENT ACTI	1.133.000	53.010	1.186.590	-1.430.651	-244.061	-----	-244.061	-69.900	65.155	-4.745	-----	-4.745
999110	GENERAL SCIENCE AND RESEARCH ACTIV	922.116	-8.862	913.254	-----	913.254	-4.781	908.471	1.116.631	-15.682	1.098.829	-5.513	1.093.316
999150	ISOTOPE PRODUCTION & DIST FUND....	-----	-----	-----	-209	-209	-----	-209	16.243	-227	16.016	-----	16.016
999105	ATOMIC ENERGY DEFENSE ACTIVITIES..	8.100.000	-2.000	8.098.000	-----	8.098.000	-1.345.625	6.752.375	9.654.834	-8.841	9.646.193	-1.923.288	7.722.905
999215	DEPARTMENTAL ADMINISTRATION.....	162.940	60.083	231.023	-17.975	213.048	-----	213.048	206.984	-2.071	202.185	-----	202.185
998182	OFFICE OF INSPECTOR GENERAL.....	-----	-----	-----	20.959	20.959	-----	20.959	22.959	-321	22.638	-----	22.638
999144	POWER MARKETING ADMINISTRATIONS:												
999165	ALASKA POWER ADMINISTRATION.....	3.159	-----	3.159	-----	3.159	-----	3.159	3.145	-11	3.134	-----	3.134
999170	BONNEVILLE POWER ADMINISTRATION...	211.200	-51.683	159.517	-----	159.517	-----	159.517	298.290	-----	298.290	-----	298.290
999171	SOUTHEASTERN POWER ADM....	36.267	-----	36.267	-----	36.267	-----	36.267	18.669	-13	18.656	-----	18.656
999188	SOUTHEASTERN CONT. FUND....	-----	3.972	3.972	-----	3.972	-----	3.972	-----	-----	-----	-----	-----
999185	SOUTHWESTERN POWER ADM....	15.389	-----	15.389	-----	15.389	-----	15.389	25.172	-115	25.057	-----	25.057
999190	SOUTHWESTERN POWER CONT. FUND.....	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
999195	WESTERN AREA POWER ADM....	273.615	-2.260	271.165	-----	271.165	-----	271.165	296.797	-579	296.218	-----	296.218
999200	NAPA EMERGENCY FUND.....	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
999205	COLORADO RIVER BASIN.....	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
999204	TOTAL, POWER MARKETING ADMINISTRAT	539.630	-50.879	488.949	-----	488.949	-----	488.949	599.783	-718	599.065	-----	599.065
999185	FERC SALARIES AND EXPENSES.....	-----	-----	-----	100.760	100.760	-----	100.760	-----	-----	-----	116.918	116.918
999136	NUCLEAR WASTE DISPOSAL FUND.....	349.032	-3.000	346.032	-----	346.032	-----	346.032	346.000	-50.844	295.156	-----	295.156
999143	GEOTHERMAL RESOURCES DEVELOPMENT F	75	-----	75	-----	75	-----	75	75	-1	74	-----	74
999161	SPECIAL FOREIGN CURRENCY.....	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
999162	ALCOHOL FUELS.....	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
999187	ALTERNATIVE FUELS PRODUCTION.....	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
989162	CLEAN COAL TECHNOLOGY.....	196.000	-2.200	187.000	-----	187.000	-----	187.000	585.000	-31.000	554.000	-----	554.000
999120	FOSSIL ENERGY RESEARCH AND DEVELOP	380.095	-3.274	377.021	-----	377.021	2.704	379.925	422.062	-9.523	416.539	102	416.641
999130	NAVAL PETROLEUM AND OIL SHALE RESE	108.071	-----	108.071	-----	108.071	-----	108.071	192.134	-2.005	189.429	-----	189.429
999135	ENERGY CONSERVATION.....	315.804	-1.675	314.129	-----	314.129	3.000	317.129	372.640	-4.574	368.072	2.844	370.916
999180	ECONOMIC REGULATION.....	21.372	-----	21.372	-----	21.372	-2.784	18.588	18.588	-----	18.588	-102	18.186
999149	EMERGENCY PREPAREDNESS.....	6.184	-----	6.184	-----	6.184	-----	6.184	6.841	-90	6.751	-----	6.751
999140	STRATEGIC PETROLEUM RESERVE.....	173.421	-----	173.421	-----	173.421	-----	173.421	196.999	-2.516	192.483	-----	192.483
989187	STRATEGIC PETROLEUM ACCOUNT.....	242.900	-----	242.900	-----	242.900	-----	242.900	319.375	116.492	435.868	-----	435.868
999145	ENERGY INFORMATION ADMINISTRATION.	62.856	-----	62.856	-----	62.856	-----	62.856	65.232	-913	64.319	-----	64.319
582190	PAYMENTS TO STATES.....	2.249	-----	2.249	-----	2.249	-----	2.249	2.249	-----	2.249	-----	2.249
999888	SUBTOTAL DOE.....	16.948.799	70.272	16.819.071	-1.121.891	15.697.180	-----	15.697.180	19.384.775	22.982	16.287.677	116.918	16.422.595

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DEPARTMENT OF ENERGY
FY 1991 CONTROL TABLE
(DOLLARS IN THOUSANDS)

BY APPROPRIATION

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A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	COMP TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
999480	EFFECT OF PRIVATIZATION:												
999490	ALABRA POWER	------	------	------	------	------	------	------	------	------	------	------	------
999492	BONNEVILLE POWER	------	------	------	------	------	------	------	------	------	------	------	------
999494	SOUTHEASTERN POWER	------	------	------	------	------	------	------	------	------	------	------	------
999496	SOUTHWESTERN POWER	------	------	------	------	------	------	------	------	------	------	------	------
999498	WESTERN AREA POWER	------	------	------	------	------	------	------	------	------	------	------	------
999500	COLORADO RIVER BASIN	------	------	------	------	------	------	------	------	------	------	------	------
999642	NAVAL PETROLEUM & OIL SHALE RESER	------	------	------	------	------	------	------	------	------	------	------	------
509668	DEFENSE PETROLEUM INVENTORY (PAC)	------	------	------	------	------	------	------	------	------	------	------	------
509670	DEFENSE PETROLEUM INVENTORY (OIL)	------	------	------	------	------	------	------	------	------	------	------	------
W9852	TOTAL DOE	14.968.799	98.272	15.019.071	-1.321.891	13.697.180	------	13.697.180	14.884.775	22.902	14.907.677	114.918	14.422.595

DOE/CT

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DEPARTMENT OF ENERGY
FY 1991 CONTROL TABLE
(DOLLARS IN THOUSANDS)

BY APPROPRIATION

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A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	COMP TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
600000	RECEIPTS												
600005	URANIUM ENRICHMENT	-1,276,000	-154,461	-1,430,461	1,430,461	------	------	------	------	------	------	------	------
600010	NAVAL PETROLEUM RESERVE	-631,293	------	-631,293	------	-631,293	------	-631,293	-629,947	------	-629,947	------	-629,947
600015	POWER MARKETING												
600020	Power Marketing	------	------	------	------	------	------	------	------	------	------	------	------
600025	Alaska	-6,747	------	-6,747	------	-6,747	------	-8,747	-8,957	------	-8,957	------	-8,957
600030	Bonneville	-123,295	------	-123,295	------	-123,295	------	-123,295	-163,100	------	-163,100	------	-163,100
600035	Southeastern	-111,605	------	-111,605	------	-111,605	------	-111,605	-128,545	------	-128,545	------	-128,545
600040	Southwestern	-79,154	------	-79,154	------	-79,154	------	-79,154	-84,375	------	-84,375	------	-84,375
600045	Western Area	-222,386	------	-222,386	------	-222,386	------	-222,386	-287,770	------	-287,770	------	-287,770
600050	Total, Power Marketing	-546,987	------	-546,987	------	-546,987	------	-546,987	-654,747	------	-654,747	------	-654,747
600055	NUCLEAR WASTE FUND - SWF	------	------	------	------	------	------	------	------	------	------	------	------
600057	UNREALIZED DISCOUNT NUCLEAR WASTE DI	------	------	------	------	------	------	------	------	------	------	------	------
600060	NUCLEAR WASTE FUND - DEFENSE	------	------	------	------	------	------	------	------	------	------	------	------
600065	NUCLEAR WASTE FUND - NON FEE	-519,294	------	-519,294	------	-519,294	------	-519,294	-530,290	------	-530,290	------	-530,290
600070	NWF - INTEREST REALIZED	-195,734	------	-195,734	------	-195,734	------	-195,734	-192,980	------	-192,980	------	-192,980
600075	OTHER	------	------	------	------	------	------	------	------	------	------	------	------
600080	FERC	-	------	------	100,760	100,760	------	100,760	-	------	-	114,910	-114,710
600085	TOTAL RECEIPTS	-3,167,310	-154,461	-3,321,961	1,531,891	-2,000,070	------	-2,000,070	-2,016,894	------	-2,016,894	-114,910	-2,131,812
600090	TOTAL BOE LESS RECEIPTS	11,701,481	-84,379	11,697,102	------	11,697,102	------	11,697,102	14,260,881	22,982	14,291,283	------	14,291,283
600092	PROPOSED LEGISLATION												
600095	EFFECT OF PRIVATIZATION RECEIPTS:												
600100	NAVAL PETROLEUM RESERVE	------	------	------	------	------	------	------	------	------	------	------	------
600102	POWER MARKETING ADMINISTRATION	------	------	------	------	------	------	------	------	------	------	------	------
600105	TOTAL, EFFECT OF PRIVATIZATION	------	------	------	------	------	------	------	------	------	------	------	------
600104	EFFECT OF REPAYMENT REFORM	------	------	------	------	------	------	------	------	------	------	------	------
600109	TOTAL, PROPOSED LEGISLATION	------	------	------	------	------	------	------	------	------	------	------	------
600110	TOTAL, BOE	11,701,481	-84,379	11,697,102	------	11,697,102	------	11,697,102	14,260,881	22,982	14,291,283	------	14,291,283
600230	ADVANCES FOR COOPERATIVE WORK												
600235	ADVANCES FOR COOPERATIVE WORK	30,519	------	30,519	------	30,519	------	30,519	27,179	------	27,179	------	27,179
600240	PROPRIETARY RECEIPTS FROM THE PUB	-30,519	------	-30,519	------	-30,519	------	-30,519	-27,179	------	-27,179	------	-27,179
600245	TOTAL, ADVANCES FOR COOPERATIVE WORK	------	------	------	------	------	------	------	------	------	------	------	------

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DEPARTMENT OF ENERGY
FY 1991 CONTROL TABLE
(DOLLARS IN THOUSANDS)

BY APPROPRIATION

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A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	CONF TRANSFER B/A	FY 1989 IN FY 90 STR B/A	CONF TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	CONF TRANSFER B/A	FY 1990 IN FY 91 STR B/A
992000	ENERGY SUPPLY R&D												
70010	SOLAR ENERGY												
70013	SOLAR BUILDINGS ENERGY SYSTEMS												
70014	OPERATING EXPENSES	5.305	-61	5.305	------	5.305	-3.000	2.305	4.955	-97	3.958	-2.846	1.112
70015	PLANT AND CAPITAL EQUIPMENT	------	------	------	------	------	------	------	150	-2	148	------	148
70016	TOTAL, SOLAR BUILDING ENERGY SYSTE	5.305	-61	5.305	------	5.305	-3.000	2.305	4.295	-99	4.106	-2.846	1.260
70049	PHOTOVOLTAIC ENERGY SYSTEMS												
70050	OPERATING EXPENSES	34.700	-354	34.346	------	34.346	------	34.346	34.606	-838	33.770	------	33.770
70051	PLANT AND CAPITAL EQUIPMENT	800	------	800	------	800	------	800	900	-11	887	------	887
70052	TOTAL, PHOTOVOLTAIC ENERGY SYSTEMS	35.500	-354	35.146	------	35.146	------	35.146	35.506	-841	34.657	------	34.657
70089	SOLAR THERMAL ENERGY SYSTEMS												
70090	OPERATING EXPENSES	14.700	-188	14.512	------	14.512	------	14.512	15.232	-366	14.866	------	14.866
70091	PLANT AND CAPITAL EQUIPMENT	300	------	300	------	300	------	300	150	-2	148	------	148
70092	TOTAL, SOLAR THERMAL ENERGY SYSTEM	15.000	-188	14.812	------	14.812	------	14.812	15.382	-368	15.014	------	15.014
70099	BIOFUELS ENERGY SYSTEMS												
70100	OPERATING EXPENSES	12.680	-205	12.675	------	12.675	600	13.275	15.780	-379	15.401	99	15.500
70101	PLANT AND CAPITAL EQUIPMENT	555	------	555	------	555	------	555	800	-11	789	------	789
70102	TOTAL, BIOFUELS ENERGY SYSTEMS	13.435	-205	13.230	------	13.230	600	13.830	16.580	-390	16.190	99	16.289
70139	WIND ENERGY SYSTEMS												
70140	OPERATING EXPENSES	8.339	-79	8.260	------	8.260	------	8.260	9.158	-229	8.928	------	8.928
70141	PLANT AND CAPITAL EQUIPMENT	500	------	500	------	500	------	500	200	-3	197	------	197
70142	TOTAL, WIND ENERGY SYSTEMS	8.839	-79	8.760	------	8.760	------	8.760	9.358	-223	9.127	------	9.127
70149	OCEAN ENERGY SYSTEMS												
70150	OPERATING EXPENSES	4.105	-35	4.070	------	4.070	------	4.070	4.078	-99	3.980	------	3.980
70151	PLANT AND CAPITAL EQUIPMENT	------	------	------	------	------	------	------	100	-1	99	------	99
70152	TOTAL, OCEAN ENERGY SYSTEMS	4.105	-35	4.070	------	4.070	------	4.070	4.178	-99	4.079	------	4.079
70259	INTERNATIONAL SOLAR ENERGY PROGRAM												
70260	OPERATING EXPENSES	1.000	------	1.000	------	1.000	------	1.000	1.054	-26	1.028	------	1.028
70261	PLANT AND CAPITAL EQUIPMENT	------	------	------	------	------	------	------	------	------	------	------	------
70262	TOTAL, INTERNATIONAL SOLAR ENERGY	1.000	------	1.000	------	1.000	------	1.000	1.054	-26	1.028	------	1.028

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DEPARTMENT OF ENERGY
FY 1991 CONTROL TABLE
(DOLLARS IN THOUSANDS)

BY APPROPRIATION

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A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	COMP TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
78243	SOLAR TECHNOLOGY TRANSFER												
78F76	OPERATING EXPENSES	2.480	———	2.480	———	2.480	———	2.480	1.823	-44	1.779	———	1.779
78273	PLANT AND CAPITAL EQUIPMENT	———	———	———	———	———	———	———	———	———	———	———	———
78272	TOTAL, SOLAR TECHNOLOGY TRANSFER	2.480	———	2.480	———	2.480	———	2.480	1.823	-44	1.779	———	1.779
78279	SOLAR ENERGY RESEARCH INSTITUTE												
78286	OPERATING EXPENSES	———	———	———	———	———	———	———	———	———	———	———	———
78281	PLANT AND CAPITAL EQUIPMENT	642	———	642	———	642	———	642	657	-9	648	———	648
78282	TOTAL, SOLAR ENERGY RESEARCH INSTI	642	———	642	———	642	———	642	657	-9	648	———	648
78281	PROGRAM SUPPORT	970	———	970	———	970	———	970	900	-21	879	———	879
78285	RESOURCE ASSESSMENT												
78284	OPERATING EXPENSES	709	———	709	———	709	———	709	772	-19	753	———	753
78287	PLANT AND CAPITAL EQUIPMENT	45	———	45	———	45	———	45	———	———	———	———	———
78286	TOTAL, RESOURCE ASSESSMENT	754	———	754	———	754	———	754	772	-19	753	———	753
78F90	PROGRAM DIRECTION - OTHER SOLAR EN	4.164	211	4.380	———	4.380	———	4.380	4.210	-44	4.166		4.166
78980	SUBTOTAL, SOLAR ENERGY	92.174	-705	91.469	———	91.469	-2.480	89.969	96.686	-2.200	92.486	-2.767	89.689
78884	COOPERATIVE VENTURE R&D POOLS	———	———	———	———	———	———	———	———	———	———	———	———
78813	GEOTHERMAL												
78814	OPERATING EXPENSES	18.761	-235	18.526	———	18.526	———	18.526	18.059	-426	17.633	———	17.633
78815	PLANT AND CAPITAL EQUIPMENT	795	———	795	———	795	———	795	450	-6	444	———	444
78816	TOTAL, GEOTHERMAL	19.964	-235	19.321	———	19.321	———	19.321	18.509	-432	18.077	———	18.077
78817	HYDROPOWER												
78818	OPERATING EXPENSES	———	———	———	———	———	———	———	———	———	———	———	———
78819	PLANT AND CAPITAL EQUIPMENT	———	———	———	———	———	———	———	———	———	———	———	———
78820	TOTAL, HYDROPOWER	———	———	———	———	———	———	———	———	———	———	———	———
78821	ELECTRIC ENERGY SYSTEMS												
78822	OPERATING EXPENSES	23.566	———	23.566	———	23.566	750	24.316	18.113	-430	17.683	145	17.828
78823	PLANT AND CAPITAL EQUIPMENT	———	———	———	———	———	———	———	———	———	———	———	———
78824	TOTAL, ELECTRIC ENERGY SYSTEMS	23.566	———	23.566	———	23.566	750	24.316	18.113	-430	17.683	145	17.828
78829	ENERGY STORAGE SYSTEMS												
78826	OPERATING EXPENSES	13.466	-275	13.191	———	13.191	-1.550	11.641	12.562	-298	12.264	-244	12.020
78881	PLANT AND CAPITAL EQUIPMENT	27	———	27	———	27	———	27	27	———	27	———	27
78832	TOTAL, ENERGY STORAGE SYSTEMS	13.493	-275	13.218	———	13.218	-1.550	11.668	12.589	-298	12.291	-244	12.047

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DEPARTMENT OF ENERGY
FY 1991 CONTROL TABLE
(DOLLARS IN THOUSANDS)

BY APPROPRIATION

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A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	COMP TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
40014	LIGHT WATER REACTOR												
40015	OPERATING EXPENSES	26.000	-334	25.666	------	25.666	------	25.666	25.000	-577	24.423	------	24.423
40016	PLANT AND CAPITAL EQUIPMENT	------	------	------	------	------	------	------	------	------	------	------	------
40017	TOTAL, LIGHT WATER REACTOR	26.000	-334	25.666	------	25.666	------	25.666	25.000	-577	24.423	------	24.423
40020	ADVANCED REACTOR R&D												
40021	OPERATING EXPENSES	79.500	-1.995	77.505	-4.720	72.785	------	72.785	58.105	-1.401	56.704	------	56.704
40022	PLANT AND CAPITAL EQUIPMENT	1.000	------	1.000	220	1.220	------	1.220	2.000	-28	1.972	------	1.972
40023	TOTAL, ADVANCED REACTOR R&D	80.500	-1.995	78.505	-4.500	74.005	------	74.005	60.105	-1.429	58.756	------	58.756
40026	FACILITIES												
40027	OPERATING EXPENSES	106.400	6.501	110.901	19.500	130.401	-6.208	124.193	165.290	-6.010	161.190	-5.250	155.940
40028	PLANT AND CAPITAL EQUIPMENT	13.800	------	13.800	------	13.800	-375	13.425	14.000	-287	14.593	-887	13.706
40029	TOTAL, FACILITIES	120.200	6.501	126.701	19.500	144.201	-6.583	139.618	180.000	-6.217	175.783	-6.137	169.646
40040	ADVANCE RADIOISOTOPE POWER SYSTEM												
40042	OPERATING EXPENSES	24.700	-1.043	23.657	7.300	30.957	-557	30.400	30.200	-423	29.777	------	29.777
40044	PLANT AND CAPITAL EQUIPMENT	3.000	-100	2.900	2.700	5.600	------	5.600	20.000	-797	19.203	------	19.203
40046	TOTAL, ADV. RADIOISOTOPE POWER SYSTE	27.700	-1.143	26.557	10.000	36.557	-557	36.000	50.200	-1.198	49.042	------	49.042
40048	SPACE REACTOR POWER SYSTEMS												
40050	OPERATING EXPENSES	60.490	16.086	76.576	-22.300	52.776	-49	52.727	21.938	-307	21.623	-44	21.579
40052	PLANT AND CAPITAL EQUIPMENT	30.510	-17.086	12.924	-2.700	10.224	------	10.224	10.160	-436	9.724	------	9.724
40054	TOTAL, SPACE REACTOR POWER SYSTEMS	91.000	-1.000	90.000	-25.000	63.000	-49	62.951	32.098	-743	31.347	-44	31.303
40071	PROGRAM DIRECTION	8.670	------	8.670	------	8.670	------	8.670	8.800	-123	8.677	------	8.677
40090	SUBTOTAL, NUCLEAR AND ACTIVITIES	352.670	27	352.697	------	352.697	-5.109	347.588	356.275	-8.247	348.028	-6.181	341.847

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DEPARTMENT OF ENERGY
FY 1991 CONTROL TABLE
(DOLLARS IN THOUSANDS)

BY APPROPRIATION

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A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	COMP TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
82010	CIVILIAN WASTE R & D	2.498	-----	2.498	-----	2.498	-----	2.498	1.000	-23	977	-----	977
82020	OPERATING EXPENSES	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
82030	PLANT AND CAPITAL EQUIPMENT	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
82040	TOTAL, CIVILIAN WASTE R & D	2.498	-----	2.498	-----	2.498	-----	2.498	1.000	-23	977	-----	977
40100	NUCLEAR ENERGY REMEDIAL ACTION AND H	252.200	-606	251.594	-----	251.594	-251.594	-----	237.000	-5.806	231.416	-231.416	-----
40101	OPERATING EXPENSES	3.100	-----	3.100	-----	3.100	-3.100	-----	1.600	-22	1.578	-1.578	-----
40102	PLANT AND CAPITAL EQUIPMENT	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
40103	GENERAL REDUCTION	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
40104	TOTAL, REMEDIAL ACTION AND WASTE TEC	255.300	-606	254.694	-----	254.694	-254.694	-----	280.600	-5.806	232.994	-232.994	-----
99085	ENVIRONMENT, SAFETY, AND HEALTH												
99000	OPERATING EXPENSES	87.900	-----	87.900	-----	87.900	-3.000	84.900	111.324	-2.622	108.984	-2.858	106.966
99011	PLANT AND CAPITAL EQUIPMENT	3.100	-----	3.100	-----	3.100	-----	3.100	3.100	-43	3.057	-121	2.936
99012	TOTAL ENVIRONMENT, SAFETY AND HEALT	91.000	-----	91.000	-----	91.000	-3.000	88.000	114.424	-2.665	111.961	-2.979	109.902

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET
(DOLLARS IN THOUSANDS)

BY APPROPRIATION

A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	COMP TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
20002	BIOLOGICAL AND ENVIRONMENTAL RESEAR												
20003	OPERATING EXPENSES	226.500	-3.258	223.242	-.090	222.352	-6.049	218.303	285.465	-6.284	279.181	-3.909	275.272
20004	PLANT AND CAPITAL EQUIPMENT	32.500	-----	32.500	-----	32.500	-.35	32.465	34.000	-1.194	84.806	-1.385	33.421
20005	TOTAL, BIOLOGICAL AND ENVIRONMENTAL	259.000	-3.258	256.742	-.090	254.852	-6.084	250.768	321.465	-7.478	313.987	-5.294	308.693
20049	MAGNETIC FUSION												
20050	OPERATING EXPENSES	317.445	-1.869	315.576	-----	315.576	-1.904	313.672	298.372	-7.279	291.093	-2.759	288.334
20051	PLANT AND CAPITAL EQUIPMENT	34.085	-2.850	31.235	-----	31.235	-248	30.987	52.378	-453	51.925	-----	51.925
20052	TOTAL, MAGNETIC FUSION	351.530	-4.689	346.811	-----	346.811	-2.152	344.659	350.750	-7.732	323.018	-2.759	320.259
20063	BASIC ENERGY SCIENCES												
20064	OPERATING EXPENSES	432.445	-6.548	425.897	-1.885	424.012	-7.998	416.014	477.825	-12.140	466.885	-8.867	456.518
20067	PLANT AND CAPITAL EQUIPMENT	120.000	-----	120.000	-----	120.000	-1.679	118.321	119.275	-1.669	117.606	-4.287	113.319
20068	TOTAL, BASIC ENERGY SCIENCES	552.445	-6.548	545.897	-1.885	544.012	-9.677	534.335	596.300	-13.809	582.491	-12.654	569.837
20045	ENERGY RESEARCH OVERSIGHT,ANALY. &												
20069	ENERGY RESEARCH ANALYSIS												
20070	OPERATING EXPENSES	3.800	-40	3.760	-----	3.760	-----	3.760	3.980	-180	3.800	-----	3.800
20071	PLANT AND CAPITAL EQUIPMENT	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
20072	TOTAL, ENERGY RESEARCH ANALYSIS	3.800	-40	3.760	-----	3.760	-----	3.760	3.980	-180	3.800	-----	3.800
20075	UNIVERSITY RESEARCH INSTRUMENTATION	5.000	-62	4.938	-----	4.938	-----	4.938	5.000	-70	4.930	-----	4.930
20079	UNIVERSITY AND SCIENCE EDUCATION P												
20080	OPERATING EXPENSES	21.770	-326	21.444	-----	21.444	-----	21.444	25.521	-606	24.915	-----	24.915
20081	PLANT AND CAPITAL EQUIPMENT	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
20082	TOTAL, UNIVERSITY AND SCIENCE EDUC	21.770	-326	21.444	-----	21.444	-----	21.444	25.521	-606	24.915	-----	24.915
20083	ADVISORY & OVERSIGHT PROG. DIRECTI	3.339	-----	3.339	-----	3.339	-----	3.339	3.373	-47	3.326	-----	3.326
20086	MULTI-PROGRAM LABORATORIES FACILITI												
20089	OPERATING EXPENSE	9.770	-----	9.770	-----	9.770	-9.770	-----	9.000	-126	8.874	-8.874	-----
20090	PLANT AND CAPITAL EQUIPMENT	57.105	-10.145	46.960	-----	46.960	-22.573	24.387	43.997	-1.114	42.883	-20.760	22.123
20091	GENERAL REDUCTION	-10.000	10.000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
20092	TOTAL, MULTI-PROGRAM LABORATIES FAC	56.875	-145	56.730	----	56.730	-31.343	24.387	52.997	-1.260	51.757	-29.634	22.123

PROJECT

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20100	SMALL BUSINESS INNOVATION RESEARCH P	------	33.104	33.104	------	33.104	------	33.104	------	------	------	------	------
50430	LIQUIFIED GASEOUS SPILL TEST FACILI												
50435	OPERATING EXPENSES.....	1.500	------	1.500	------	1.500	------	1.500	1.950	-25	1.925	------	1.925
50440	PLANT AND CAPITAL EQUIPMENT....	------	------	------	------	------	------	------	------	------	------	------	------
50442	TOTAL, LIQUIFIED GASEOUS SPILL TEST	1.500	------	1.500	------	1.500	------	1.500	1.950	-25	1.925	------	1.925
999352	IN-HOUSE ENERGY MANAGEMENT												
159402	OPERATING EXPENSES.....	2.000	------	2.000	------	2.000	------	2.000	2.020	-28	1.992	------	1.992
159403	PLANT AND CAPITAL EQUIP.....	17.520	-88	17.432	------	17.432	------	17.432	18.080	-618	17.462	------	17.462
999353	TOTAL, IN-HOUSE ENERGY MANAGEMENT..	19.520	-88	19.432	------	19.432	------	19.432	20.100	-626	19.474	------	19.474
103000	STRATEGIC FACILITIES UTILIZATION PR												
103002	OPERATING EXPENSES.....	1.977	------	1.977	------	1.977	------	1.977	1.977	-28	1.949	------	1.949
103004	PLANT AND CAPITAL EQUIPMENT....	198	------	198	------	198	------	198	198	-3	195	------	195
103004	TOTAL, STRATEGIC FACILITIES UTILIZA	2.175	------	2.175	------	2.175	------	2.175	2.175	-31	2.144	------	2.144
159004	TECHNICAL INFORMATION & MANAGEMENT												
159007	OPERATING EXPENSES.....	13.100	------	13.100	------	13.100	------	13.100	13.050	-194	12.856	------	12.856
159008	PLANT AND CAPITAL EQUIPMENT....	3.400	------	3.400	------	3.400	------	3.400	1.350	-16	1.334	------	1.334
159010	TOTAL, TECHNICAL INFORMATION & MANA	16.500	------	16.500	------	16.500	------	16.500	15.900	-210	14.790	------	14.790
20100	POLICY AND MANAGEMENT - ED (ERAD)..	667	------	667	------	667	------	667	674	-9	665	------	665
40107	POLICY AND MANAGEMENT - HE (ERAD)..	2.168	------	2.168	------	2.168	1.980	5.148	2.298	-31	2.169	2.959	5.128
70000	POLICY A[illegible]EMENT - CE(ERAD)...	1.700	-176	1.587	------	1.587	------	1.587	1.563	-22	1.541	------	1.541
990389	TOTAL, ENERGY [illegible] R & D	2.167.276	35.978	2.203.254	-2.775	2.160.479	-810.139	1.880.340	2.236.444	-52.017	2.184.449	-292.362	1.892.087
20220	SECR (HEAT ENERGY, PEI PRIOR YEAR	------	------	------	------	------	------	------	------	------	------	------	------
210600	USE OF UNOBLIG. BALANCES - UE.....	------	------	------	------	------	------	------	------	------	------	------	------
210650	USE OF UNOB BAL - (ERAD).....	-4.950	3.083	-1.867	------	-1.867	------	-1.867	------	------	------	------	------
210652	GENERAL REDUCTION (ERAD).....	------	------	------	------	------	------	------	-21.000	21.000	------	------	------
40400	GENERAL REDUCTION (HE).....	------	------	------	------	------	------	------	------	------	------	------	------
990890	TOTAL, ENERGY SUPPLY R & D.....	2.162.326	19.861	2.181.687	-2.775	2.159.112	-810.139	1.848.973	2.215.444	-31.017	2.184.449	-292.362	1.892.087
990891	(OPERATING EXPENSES).....	1.819.594	50.300	1.869.674	-2.995	1.866.679	-382.129	1.484.550	1.999.296	-24.482	1.884.842	-263.844	1.621.498
990892	(PLANT AND CAPITAL EQUIPMENT)	322.732	-30.719	292.213	220	292.433	-28.010	264.423	216.172	-6.565	299.637	-29.018	270.589

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99869	ENVIRONMENTAL RESTORATION AND WASTE												
98005	CORRECTIVE ACTIVITIES (ER)												
98010	OPERATING EXPENSES	-----	-----	-----	-----	-----	14.662	14.662	-----	-----	-----	15.717	15.717
98015	PLANT AND CAPITAL EQUIPMENT	-----	-----	-----	-----	-----	14.461	14.461	-----	-----	-----	19.538	19.538
98020	TOTAL, CORRECTIVE ACTIVITIES (ER)	-----	-----	-----	-----	-----	29.123	29.123	-----	-----	-----	35.255	35.255
98021	CORRECTIVE ACTIVITIES (BP)												
98022	OPERATING EXPENSES	-----	-----	-----	-----	-----	0.347	0.347	-----	-----	-----	13.672	13.672
98023	PLANT AND CAPITAL EQUIPMENT	-----	-----	-----	-----	-----	30.710	30.710	-----	-----	-----	60.809	60.809
98024	TOTAL, CORRECTIVE ACTIVITIES (BP)	-----	-----	-----	-----	-----	29.057	29.057	-----	-----	-----	74.481	74.481
98025	CORRECTIVE ACTIVITIES (ER)												
98026	OPERATING EXPENSES	-----	-----	-----	-----	-----	687	687	-----	-----	-----	1.378	1.378
98027	PLANT AND CAPITAL EQUIPMENT	-----	-----	-----	-----	-----	15.535	15.535	-----	-----	-----	14.645	14.645
98030	TOTAL, CORRECTIVE ACTIVITIES (ER)	-----	-----	-----	-----	-----	16.222	16.222	-----	-----	-----	16.023	16.023
98029	CORRECTIVE ACTIVITIES (HE)												
98030	OPERATING EXPENSES	-----	-----	-----	-----	-----	452	452	-----	-----	-----	601	601
98031	PLANT AND CAPITAL EQUIPMENT	-----	-----	-----	-----	-----	200	200	-----	-----	-----	394	394
98032	TOTAL, CORRECTIVE ACTIVITIES (HE)	-----	-----	-----	-----	-----	652	652	-----	-----	-----	995	995
99869	TOTAL, CORRECTIVE ACTIVITIES	-----	-----	-----	-----	-----	85.054	85.054	-----	-----	-----	126.754	126.754

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98033	ENVIRONMENTAL RESTORATION (ER)												
98034	OPERATING EXPENSES	-----	-----	-----	-----	-----	414.404	414.404	-----	-----	-----	650.539	650.539
98035	PLANT AND CAPITAL EQUIPMENT	-----	-----	-----	-----	-----	5.278	5.278	-----	-----	-----	6.290	6.290
98040	TOTAL, ENVIRONMENTAL RESTORATION (ER	-----	-----	-----	-----	-----	419.682	419.682	-----	-----	-----	656.829	656.829
98045	WASTE MANAGEMENT (ER)												
98050	OPERATING EXPENSES	-----	-----	-----	-----	-----	841.591	841.591	-----	-----	-----	1.020.091	1.020.091
98055	PLANT AND CAPITAL EQUIPMENT	-----	-----	-----	-----	-----	253.688	253.688	-----	-----	-----	227.612	227.612
98060	TOTAL, WASTE MANAGEMENT (ER)	-----	-----	-----	-----	-----	1.095.279	1.095.279	-----	-----	-----	1.247.703	1.247.703
98065	TECHNOLOGY DEVELOPMENT (ER)												
98070	OPERATING EXPENSES	-----	-----	-----	-----	-----	51.005	51.005	-----	-----	-----	100.134	100.134
98075	PLANT AND CAPITAL EQUIPMENT	-----	-----	-----	-----	-----	827	827	-----	-----	-----	3.347	3.347
98080	TOTAL, TECHNOLOGY DEVELOPMENT (ER)	-----	-----	-----	-----	-----	51.832	51.832	-----	-----	-----	103.481	103.481
98090	PROGRAM DIRECTION	-----	-----	-----	-----	-----	5.500	5.500	-----	-----	-----	5.550	5.550
98095	SUBTOTAL, ENV. RESTORATION & WASTE M	-----	-----	---	-----	-----	1.657.347	1.657.347	-----	-----	-----	2.218.317	2.218.317
98097	PROGRAM SLIPPAGE DUE TO DELAYS IN P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
980402	TOTAL, ENVIRONMENTAL RESTORATION AND	-----	-----	-----	-----	-----	1.657.347	1.657.347	-----	-----	-----	2.218.317	2.218.317
980404	(OPERATING EXPENSES)	-----	-----	-----	-----	-----	1.336.648	1.336.648	-----	-----	-----	1.885.682	1.885.682
980406	(PLANT AND CAPITAL EQUIPMENT)	-----	-----	-----	-----	-----	320.699	320.699	-----	-----	-----	332.635	332.635

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993000	URANIUM ENRICHMENT												
40108	URANIUM ENRICHMENT ACTIVITIES												
40109	OPERATING EXPENSES	1,182,600	53,510	(.156,110	4,041	1,168,959	-55,838	1,105,121	1,359,700	-17,437	1,342,063	-73,242	1,268,821
40110	PLANT AND CAPITAL EQUIPMENT	78,004	------	78,000	-4,041	65,151	-6,276	60,883	66,700	-860	65,340	-6,435	58,905
40111	URANIUM PROGRAM DIRECTION	4,000	------	4,000	------	4,000	------	4,000	5,100	-66	5,034	------	5,034
40114	SUBTOTAL, URANIUM ENRICHMENT AC	1,176,600	53,510	1,230,110	------	1,230,110	-60,114	1,170,004	1,431,000	-18,563	1,412,437	-79,677	1,332,760
40113	PAYMENT TO TREASURY ON DED? - D	------	------	------	------	------	------	------	------	------	------	------	------
40114	CONTRIBUTION TO DECONTAMINATION	------	------	------	------	------	------	------	------	------	------	------	------
40115	DIVIDENDS	------	------	------	------	------	------	------	------	------	------	------	------
40119	SUBTOTAL, URANIUM ENRICHMENT ACTIVI	1,176,600	53,510	1,230,110	------	1,230,110	-60,114	1,170,004	1,431,000	-18,563	1,412,437	-79,677	1,332,760
40126	CORRECTIVE ACTIVITIES												
40127	OPERATING EXPENSES	------	------	------	------	------	1,578	1,578	------	------	------	5,122	5,122
40128	PLANT AND CAPITAL EQUIPMENT	------	------	------	------	------	3,023	3,023	------	------	------	2,415	2,415
40129	SUBTOTAL, CORRECTIVE ACTIVITIES	------	------	------	------	------	4,601	4,601	------	------	------	7,537	7,537
40130	ENVIRONMENTAL RESTORATION												
40131	OPERATING EXPENSES	------	------	------	------	------	46,189	46,189	------	------	------	50,426	50,426
40132	PLANT AND CAPITAL EQUIPMENT	------	------	------	------	------	------	------	------	------	------	------	------
40133	SUBTOTAL, ENVIRONMENTAL RESTORATION	------	------	------	------	------	46,189	46,189	------	------	------	50,426	50,426
40134	WASTE MANAGEMENT												
40135	OPERATING EXPENSES	------	------	------	------	------	8,080	8,080	------	------	------	9,694	9,694
40136	PLANT AND CAPITAL EQUIPMENT	------	------	------	------	------	1,253	1,253	------	------	------	4,020	4,020
40137	SUBTOTAL, WASTE MANAGEMENT	------	------	------	------	------	9,333	9,333	------	------	------	13,714	13,714
993090	SUBTOTAL, URANIUM ENRICHMENT	1,176,600	53,510	1,230,110	------	1,230,110	------	1,230,110	1,431,000	-18,563	1,412,437	------	1,412,437
40144	REVENUES FOR THE D&D FUND (NON-	------	------	------	------	------	------	------	------	------	------	------	------
40145	REVENUES	------	------	------	-1,439,651	-1,439,651	------	-1,439,651	-1,509,900	83,718	-1,617,182	------	-1,617,182
40405	USE OF PRIOR BALANCE-(NEW	-43,529	------	-43,529	------	-43,529	------	-43,529	------	------	------	------	------
40182	TOTAL, URANIUM ENRICHMENT ACTIVITIES	1,133,089	53,510	1,186,550	-1,439,651	-264,963	------	-264,963	-69,900	65,155	-4,765	------	-4,765
993091	(OPERATING EXPENSES)	1,106,600	53,510	1,160,110	-1,425,810	-265,692	------	-265,692	-136,100	66,015	-70,085	------	-70,085
993092	(PLANT AND CAPITAL EQUIPMENT)	26,489	------	26,489	-4,041	21,639	------	21,639	66,200	-860	65,340	------	65,340

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991590	GENERAL SCIENCE AND RESEARCH ACTIVIT												
20110	HIGH ENERGY PHYSICS												
20111	OPERATING EXPENSES	530.606	-12.841	517.765	-84.000	433.765	-2.054	430.911	482.700	-16.489	466.291	-3.595	462.096
20112	PLANT AND CAPITAL EQUIPMENT	136.200	-----	136.200	-16.000	120.200	-1.320	118.872	123.450	-3.090	120.360	-1.179	119.181
20113	TOTAL, HIGH ENERGY PHYSICS	666.806	-12.841	653.965	-100.000	553.965	-4.182	549.783	606.210	-19.579	586.651	-4.574	582.077
20115	SUPERCONDUCTING SUPER COLLIDER												
20116	OPERATING EXPENSES	-----	-2.415	-2.415	84.000	81.585	522	82.107	69.000	-964	68.036	836	68.872
20117	PLANT AND CAPITAL EQUIPMENT	-----	-----	-----	16.000	16.000	-----	16.000	156.000	-6.582	149.698	-----	149.698
20118	TOTAL, SUPERCONDUCTING SUPER COLLID	-----	-2.415	-2.415	100.000	97.585	522	98.107	225.000	-7.268	217.732	836	218.570
20121	NUCLEAR PHYSICS												
20122	OPERATING EXPENSES	198.100	-5.883	187.547	-----	187.547	-681	186.966	196.200	-6.905	189.295	-939	190.486
20123	PLANT AND CAPITAL EQUIPMENT	71.000	-----	71.000	-----	71.000	-----	71.000	94.000	-2.795	91.205	-----	91.205
20124	TOTAL, NUCLEAR PHYSICS	264.100	-5.883	258.547	-----	258.547	-681	257.966	290.200	-9.700	280.500	-939	289.661
20125	GENERAL SCIENCE PROGRAM DIRECTION (	5.210	-53	5.157	-----	5.157	-522	7.635	5.981	-88	5.844	-838	5.006
991593	TOTAL, GENERAL SCIENCE	936.116	-20.862	913.254	-----	913.254	-6.783	908.471	1.128.431	-36.682	1.090.829	-5.513	1.093.316
20212	GENERAL REDUCTION - (ER)NR	-12.000	12.000	-----	-----	-----	-----	-----	-21.000	21.000	-----	-----	-----
991594	TOTAL, GENERAL SCIENCE AND RESEARCH	922.116	-8.862	913.254	-----	913.254	-6.783	908.471	1.114.431	-15.682	1.098.829	-5.513	1.093.316
991691	(OPERATING EXPENSES)	714.916	-8.862	706.054	-----	706.054	-8.488	702.699	748.981	-8.415	737.566	-4.534	733.282
991892	(PLANT AND CAPITAL EQUIPMENT)	217.200	-----	217.200	-----	217.200	-1.320	218.872	171.450	-12.187	361.263	-1.179	360.084

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40160	ISOTOPE PRODUCTION AND DISTRIBUTION												
40162	ISOTOPE PRODUCTION.....	-----	-----	-----	16.243	16.243	-----	16.243	16.243	-227	16.016	-----	16.016
40164	ISOTOPE SALES.....	-----	-----	-----	-16.452	-16.452	-----	-16.452	-----	-----	-----	-----	-----
40164	SUBTOTAL, ISOTOPE PRODUCTION & DIST	-----	-----	-----	-209	-209	-----	-209	16.243	-227	16.016	-----	16.016

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99:000	ATOMIC ENERGY DEFENSE ACTIVITIES												
10010	RESEARCH, DEVELOPMENT AND TESTING												
10011	OPERATING EXPENSES	1.190.500	-14.000	1.176.500	377.704	1.554.204	-24.001	1.530.203	1.576.470	-23.451	1.553.019	-22.184	1.530.915
10014	PLANT AND CAPITAL EQUIPMENT	296.543	-4.769	291.774	40.023	331.797	-22.046	309.151	361.025	-5.414	355.611	-22.690	332.921
10017	TOTAL, RESEARCH AND DEVELOPMENT AND	1.487.043	-18.769	1.468.274	417.807	1.886.081	-46.047	1.839.434	1.937.495	-29.865	1.908.630	-44.794	1.863.836
10019	NUCLEAR DIRECTED ENERGY WEAPONS												
10020	OPERATING EXPENSES	222.254	------	222.254	-222.254	------	------	------	------	------	------	------	------
10021	PLANT AND CAPITAL EQUIPMENT	32.746	-655	32.091	-32.091	------	------	------	------	------	------	------	------
10022	TOTAL, NUCLEAR DIRECTED ENERGY WEAP	255.000	-655	254.345	-254.345	------	------	------	------	------	------	------	------
10024	INERTIAL CONFINEMENT FUSION												
10025	OPERATING EXPENSES	155.530	------	155.530	-155.530	------	------	------	------	------	------	------	------
10026	PLANT AND CAPITAL EQUIPMENT	8.240	-308	7.932	-7.932	------	------	------	------	------	------	------	------
10027	TOTAL, INERTIAL CONFINEMENT FUSION,	163.770	-308	163.462	-163.462	------	------	------	------	------	------	------	------
10029	PRODUCTION AND SURVEILLANCE												
10030	OPERATING EXPENSES	1.909.445	------	1.909.445	------	1.909.445	-115.600	1.793.757	2.100.000	-31.500	2.068.500	-100.283	1.968.217
10031	PLANT AND CAPITAL EQUIPMENT	337.703	-4.917	332.866	------	332.866	-22.717	310.149	467.374	-6.711	460.663	-84.362	406.301
10032	TOTAL, PRODUCTION AND SURVEILLANCE,	2.247.220	-4.917	2.242.311	------	2.242.311	-138.405	2.103.906	2.567.374	-38.211	2.529.163	-184.645	2.374.518
10035	PROGRAM DIRECTION - DEFENSE PROGRAM												
10040	OPERATING EXPENSES	81.488	------	81.488	------	81.488	1.765	83.165	97.903	-1.469	96.434	1.261	97.695
10042	PLANT AND CAPITAL EQUIPMENT	------	------	------	------	------	------	------	1.735	-26	1.709	------	1.709
10045	TOTAL, PROGRAM DIRECTION - DEFENSE	81.488	------	81.488	------	81.488	1.765	83.165	99.638	-1.495	98.143	1.261	99.404
10047	TOTAL, WEAPONS PROGRAMS	4.234.041	-24.649	4.209.792	------	4.209.792	-183.287	4.026.505	4.504.707	-68.771	4.435.936	-178.178	4.257.758
10049	MATERIALS PRODUCTION												
10060	OPERATING EXPENSES	1.584.772	181.434	1.688.106	-25.883	1.662.106	-106.156	1.557.950	1.684.691	110.178	1.794.869	-101.679	1.693.199
10061	PLANT AND CAPITAL EQUIPMENT	429.087	17.091	446.978	-35.888	411.978	-26.289	385.670	503.883	-7.389	496.824	-67.199	429.125
10062	TOTAL, MATERIALS PRODUCTION	1.989.859	149.345	2.135.104	-60.000	2.075.104	-132.446	1.942.700	2.150.574	102.619	2.291.193	-168.849	2.092.324
15005	MOX PRODUCTION REACTORS												
15010	OPERATING EXPENSES	------	35.000	35.000	25.000	60.000	------	60.000	208.500	-5.052	203.448	------	203.448
15012	PLANT AND CAPITAL EQUIPMENT	------	-35.000	-35.000	35.000	------	------	------	100.000	-1.500	98.500	------	98.500
15020	TOTAL, MOX PRODUCTION REACTORS	------	------	------	60.000	60.000	------	60.000	303.500	-6.552	296.948	------	296.948

PROJECT — DEPARTMENT OF ENERGY — BY APPROPRIATION

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(DOLLARS IN THOUSANDS)

A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	COMP TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
90001	WASTE TRANSPORTATION & SITE MGMT...												
90002	OPERATING EXPENSES.....	771.824	55.600	826.424	------	826.424	-811.020	15.396	1.661.875	-21.627	1.620.248	-1.595.463	24.785
90003	PLANT AND CAPITAL EQUIPMENT....	246.876	627	247.503	------	247.503	-218.654	28.849	217.092	-3.258	213.834	-178.764	35.069
90004	USE OF PRIOR YEAR AED BALANCES.	-63.000	63.000	------	------	------	------	------	------	------	------	------	------
90005	TOTAL. WASTE TRANSPORTATION & SITE	974.900	99.027	1.073.927	------	1.073.927	-1.029.682	44.245	1.658.967	-24.885	1.634.082	-1.574.229	59.853
10069	VERIFICATION AND CONTROL TECHNOLOGY												
10060	OPERATING EXPENSES.....	146.200	650	146.850	------	146.850	------	146.850	159.146	-2.387	156.759	-1.496	155.263
10061	PLANT AND CAPITAL EQUIPMENT....	8.600	-614	7.786	------	7.786	------	7.786	10.732	-161	10.571	------	10.571
10062	TOTAL. VERIFICATION AND CONTROL TEC	154.600	36	154.636	------	154.636	------	154.636	169.878	-2.548	167.330	-1.496	165.834
10095	NUCLEAR SAFEGUARDS & SECURITY												
10096	OPERATING EXPENSES.....	75.400	-950	74.450	------	74.450	------	74.450	82.261	-1.234	81.007	-516	80.491
10097	PLANT AND CAPITAL EQUIPMENT....	4.000	-100	4.620	------	4.620	------	4.620	4.967	-75	4.892	------	4.892
10099	TOTAL. NUCLEAR SAFEGUARDS & SECURIT	80.200	-1.150	79.070	------	79.070	------	79.070	87.288	-1.309	85.899	-516	85.383
10100	SECURITY INVESTIGATIONS												
10101	OPERATING EXPENSES.....	40.000	3.200	43.200	------	43.200	------	43.200	41.200	-618	40.582	------	40.582
40104	NAVAL REACTORS DEVELOPMENT												
40105	OPERATING EXPENSES.....	555.400	------	555.400	------	555.400	------	555.400	562.000	-8.441	554.359	------	554.359
40106	PLANT AND CAPITAL EQUIPMENT....	74.600	------	74.600	------	74.600	------	74.600	89.280	-1.336	87.844	------	87.844
40107	TOTAL. NAVAL REACTORS DEVELOPMENT..	630.000	------	630.000	------	630.000	------	630.000	652.000	-9.777	642.223	------	642.223
991093	TOTAL. ATOMIC ENERGY.....	8.100.000	228.077	8.328.077	------	8.328.077	-1.345.425	6.980.652	9.656.034	-9.841	9.646.193	-1.923.288	7.722.905
10204	USE OF FY FUNDING (OMNIBUS REPROG	------	-227.077	-227.077	------	-227.077	------	-227.077	------	------	------	------	------
10189	RESOURCES NEEDED FOR "TIGER TEAM"	------	------	------	------	------	------	------	------	------	------	------	------
991095	TOTAL. ATOMIC ENERGY DEFENSE ACTIVIT	8.100.000	-7.000	8.093.000	------	8.093.000	-1.345.425	6.752.575	9.656.034	-9.841	9.646.193	-1.923.288	7.722.905
991091	(OPERATING EXPENSES).....	6.660.925	25.925	6.686.850	------	6.686.850	-1.056.188	5.631.742	7.920.826	16.199	7.936.225	-1.620.271	6.315.954
991092	(PLANT AND CAPITAL EQUIPMENT)	1.439.075	-27.925	1.411.150	------	1.411.150	-290.237	1.120.913	1.735.208	-26.040	1.709.168	-303.017	1.406.951

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DEPARTMENT OF ENERGY
FY 1991 CONTROL TABLE
(DOLLARS IN THOUSANDS)

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A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	CSRP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	CSRP TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	JSRP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
999000	DEPARTMENTAL ADMINISTRATION												
144005	OFFICE OF THE SECRETARY	2.294	502	2.796	-----	2.796	-----	2.796	2.106	1.900	4.006	-----	4.006
162005	BOARD OF CONTRACT APPEALS	436	-29	407	-----	407	-----	407	400	73	473	-----	473
164004	GENERAL COUNSEL	10.874	252	11.126	-----	11.126	-----	11.126	10.710	1.054	11.752	-----	11.752
178010	INSPECTOR GENERAL - OE	20.661	1.867	22.528	-22.528	-----	-----	-----	-----	-----	-----	-----	-----
178012	INSPECTOR GENERAL - CE	298	-298	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
178100	TOTAL, INSPECTOR GENERAL	20.959	1.569	22.528	-22.528	-----	-----	-----	-----	-----	-----	-----	-----
181999	MANAGEMENT AND ADMINISTRATION												
182000	OPERATING EXPENSES	158.513	9.974	168.487	-----	168.487	-----	168.487	156.115	8.129	164.244	-----	164.244
182005	PLANT AND CAPITAL EQUIPMENT	5.612	608	6.220	-----	6.220	-----	6.220	1.975	463	2.438	-----	2.438
182009	TOTAL MANAGEMENT AND ADMINISTRATION	164.125	10.582	166.707	-----	166.707	-----	166.707	158.090	8.592	166.682	-----	166.682
183024	OPERATIONS OFFICES												
183025	OPERATING EXPENSES	106.803	6.161	112.964	-----	112.964	-----	112.964	110.597	-1.505	109.092	-----	109.092
183026	PLANT AND CAPITAL EQUIPMENT	1.252	-134	1.118	-----	1.118	-----	1.118	1.298	-136	1.162	-----	1.162
183028	TOTAL, OPERATIONS OFFICES	107.595	6.027	113.062	-----	113.062	-----	113.062	111.895	-1.641	110.254	-----	110.254
200010	MINORITY ECONOMIC IMPACT	4.907	-2.005	1.202	-----	1.202	-----	1.202	6.192	2.978	7.072	-----	7.072
220010	POLICY ANALYSIS AND SYSTEM STUDIES	6.221	-495	5.726	-----	5.726	-----	5.726	6.229	2.350	8.579	-----	8.579
99989)	CONGRESSIONAL, INTERGOV. AFFAIRS												
190027	PROGRAM DIRECTION	4.695	709	5.404	-----	5.404	-1.407	4.017	6.044	1.796	6.040	-2.105	4.295
190028	INDIAN AFFAIRS	-----	309	309	-----	309	-----	309	-----	-----	-----	-----	-----
190050	CONSUMER AFFAIRS	67	-33	34	-----	34	-----	34	65	-1	64	-----	64
190029	PUBLIC AFFAIRS	260	-219	41	-----	41	-41	-----	269	-3	266	-266	-----
190021	COMPETITION	50	-50	-----	-----	-----	-----	-----	50	-1	69	-----	69
999092	TOTAL, CONGRESS., INTERGOV. AFFAIRS	5.032	796	5.828	-----	5.828	-1.448	4.380	5.828	1.791	6.819	-2.421	4.398
999093	PUBLIC AFFAIRS												
192005	PUBLIC AFFAIRS	-----	-----	-----	-----	-----	41	41	-----	-----	-----	266	266
192010	PROGRAM DIRECTION	-----	-----	-----	-----	-----	1.407	1.407	-----	-----	-----	2.155	2.155
999094	TOTAL, PUBLIC AFFAIRS	-----	-----	-----	-----	-----	1.448	1.448	-----	-----	-----	2.421	2.421
140100	INTERNATIONAL AFFAIRS	5.545	83	5.628	-----	5.628	-----	5.628	5.594	988	6.582	-----	6.582
999095	SUBTOTAL, ADMINISTRATIVE OPERATIONS	319.010	16.402	335.429	-22.528	312.892	-----	312.892	304.256	18.062	322.318	-----	322.318

A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	CDMP TRANSFER B/A	FY 1989 IN FY 90 $TP B/A	CDMP TRANSFER B/A	FY 1989 IN FY 91 $TP B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	CDMP TRANSFER B/A	FY 1990 IN FY 91 $TP B/A
159015	COST OF WORK FOR OTHERS	129.880	------	129.880	-13.446	115.562	------	115.562	83.899	-1.074	82.825	------	82.825
159016	GENERAL REDUCTION	------	------	------	------	------	------	------	------	------	------	------	------
159018	REVENUES ASSOCIATED WITH COST OF WOR	-153.660	------	-153.660	16.662	-137.998	------	-137.998	-97.200	2.100	-95.200	------	-95.200
159019	OTHER REVENUES	-87.265	68.883	-18.382	------	-18.382	------	-18.382	-52.700	------	-52.700	------	-52.700
159021	SUBTOTAL, REVENUES	-240.725	68.883	-171.842	16.662	-155.180	------	-156.180	-150.000	2.100	-147.900	------	-147.900
999098	TOTAL, DEPARTMENTAL ADMINISTRATION	297.823	95.205	392.688	-19.944	275.044	------	273.044	280.195	19.888	257.243	------	257.243
159120	USE OF PRIOR YEAR BALANCES - (PA)DA	------	------	------	------	------	------	------	------	------	------	------	------
159500	TRANSFER FOR SSC	------	------	------	------	------	------	------	------	------	------	------	------
192012	USE OF UNOBLIGATED BALANCES - (PA)DA	------	------	------	------	------	------	------	------	------	------	-776	-776
120030	USE OF UNOBLIGATED BALANCES - (PP)(D	------	495	495	------	495	------	495	------	-2.630	-2.630	------	-2.630
140110	USE OF UNOBLIGATED BALANCES - (IA)D	------	-83	-83	------	-83	------	-83	------	-1.062	-1.062	------	-1.062
159969	USE OF UNOBLIGATED BAL. & MANAGEMENT	-84.883	-10.062	-94.945	------	-94.945	------	-94.945	-33.899	-10.614	-43.715	------	-43.715
160014	USE OF UNOBLIGATED BALANCES - (BC)D	------	-252	-252	------	-252	------	-252	------	-1.171	-1.171	------	-1.171
162809	USE OF UNOBLIGATED BALANCES - (BCA)	------	29	29	------	29	------	29	------	-78	-78	------	-78
164009	USE OF UNOBLIGATED BALANCES - (NBEC	------	-502	-502	------	-502	------	-502	------	-1.932	-1.932	------	-1.932
170316	USE OF UNOBLIGATED BALANCES - (IB) D	----	-1.949	-1.949	------	------	------	------	------	-	-	----	----
190063	USE OF UNOBLIGATED BALANCES - (CP)	------	-796	-796	------	-796	------	-796	------	-1.056	-1.056	776	-1.079
200016	USE OF UNOBLIGATED BALANCES - (NE)D	------	2.885	2.885	------	2.885	------	2.885	------	-3.823	-3.823	------	-3.823
159961	USE OF UNOBLIGATED BALANCES - (DS)D	------	-6.827	-6.827	------	-6.827	------	-6.827	------	298	298	------	298
159962	A-76 STUDIES	------	------	------	------	------	------	------	------	------	------	------	------
999099	TOTAL, DEPARTMENTAL ADMINISTRATION	162.960	68.883	231.823	-17.975	213.848	------	213.848	246.864	-2.871	242.185	------	242.185
999096	(OPERATING EXPENSES -	155.778	68.707	224.485	-17.975	206.510	------	206.510	201.783	-3.190	198.594	------	198.585
999097	(PLANT AND CAPITAL EQUIPMENT	7.182	176	7.358	------	7.358	------	7.358	5.273	327	5.600	------	5.600

R06CT

DEPARTMENT OF ENERGY

BY APPROPRIATION

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FY 1991 CONTROL TABLE

PAGE 14

(DOLLARS IN THOUSANDS)

A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	COMP TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
17R54m	OFFICE OF INSPECTOR GENERAL												
17R54N	INSPECTOR GENERAL - GE	———	———	———	22.520	22.520	———	22.520	22.959	2.979	25.938	———	25.938
17R510	USE OF UNOBLIGATED BALANCES	———	———	———	-1.569	-1.569	———	-1.569	———	-3.300	-3.300	———	-3.300
17R515	TOTAL, OFFICE OF THE INSPECTOR GENER	———	———	———	20.959	20.959	———	20.959	22.959	-321	22.638	———	22.638

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DEPARTMENT OF ENERGY

BY APPROPRIATION

FY 1991 CONGRESSIONAL TABLE

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(DOLLARS IN THOUSANDS)

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A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	CSNP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	CSNP TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	CSNP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
997000	ALASKA POWER GRP												
76450	POWER MARKETING - ALASKA POWER ADMI	3.279	------	3.279	------	3.279	------	3.279	3.165	-11	3.154	------	3.154
76703	USE OF PRIOR YEAR BALANCES - (CE)A	-129	------	-129	------	-129	------	-129	------	------	------	------	------
997000	TOTAL, ALASKA POWER	3.150	------	3.150	------	3.150	------	3.150	3.165	-11	3.154	------	3.154
70848	EFFECT OF PRIVATIZATION - APA	------	------	------	------	------	------	------	------	------	------	------	------
70891	PRIV. - SALE OF ASSETS - APAINSP-ADD	------	------	------	------	------	------	------	------	------	------	------	------
999467	TOTAL, ALASKA POWER	3.150	------	3.150	------	3.150	------	3.150	3.165	-11	3.154	------	3.154

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(DOLLARS IN THOUSANDS)

A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 STD B/A	COMP TRANSFER B/A	FY 1989 IN FY 91 STD B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STD B/A
997290	BONNEVILLE												
81060	POWER MARKETING - BONNEVILLE POWER	211.290	-81.683	189.617	------	189.617	------	189.617	250.290	------	250.290	------	250.290
81811	PERMANENT INDEFINITE BORROWING AUTH	------	------	------	------	------	------	------	------	------	------	------	------
997290	TOTAL, BONNEVILLE POWER ADMIN	211.290	-81.683	189.617	------	189.617	------	189.617	250.290	------	250.290	------	250.290
81065	EFFECT OF PRIVATIZATION - BPA (NON-A	------	------	------	------	------	------	------	------	------	------	------	------
81063	EFFECT OF PRIVATIZATION - BPA	------	------	------	------	------	------	------	------	------	------	------	------
81066	PRIV. - SALE OF ASSETS - BPA(NON-ADD	------	------	------	------	------	------	------	------	------	------	------	------
81067	TOTAL, BONNEVILLE POWER ADMINISTRATI	211.290	-81.683	189.617	------	189.617	------	189.617	250.290	------	250.290	------	250.290

BUDGET — DEPARTMENT OF ENERGY — BY APPROPRIATION

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(DOLLARS IN THOUSANDS)

A/S CODE	ACCOUNT TITLE	FY 1989 COMPARABLE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	CBNP TRANSFER B/A	FY 1989 In FY 90 STR B/A	CBNP TRANSFER B/A	FY 1990 In FY 91 STR B/A	FY 1990 COMPARABLE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	CBNP TRANSFER B/A	FY 1990 In FY 91 STR B/A
997400	SOUTHEASTERN GBA												
78670	POWER MARKETING - SOUTHEASTERN PGAE	34,267	------	34,267	------	34,267	------	34,267	30,669	-13	30,656	------	30,656
79757	RESCISSIONS, DEFERRAL, SUPP. OE IS	------	------	------	------	------	------	------	------	------	------	------	------
997499	TOTAL, SOUTHEASTERN GBA	34,267	------	34,267	------	34,267	------	34,267	30,669	-13	30,656	------	30,656
79867	EFFECT OF PROPOSITION- SEPA	------	------	------	------	------	------	------	------	------	------	------	------
79868	PBIV - SALE OF ASSETS - SEPASOUTHEAST	------	------	------	------	------	------	------	------	------	------	------	------
999470	TOTAL, SOUTHEASTERN GBA	34,267	------	34,267	------	34,267	------	34,267	30,669	-13	30,656	------	30,656
997500	SOUTHEASTERN CONT. FUND												
79185	SOUTHEASTERN POWER - CONT. FUND	------	3,071	3,071	------	3,071	------	3,071	------	------	------	------	------
997599	TOTAL, SOUTHEASTERN CONT. FUND	------	3,071	3,071	------	3,071	------	3,071	------	------	------	------	------

A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
997898	SOUTHWESTERN O&M												
70400	POWER MARKETING - SOUTHWESTERN POWE	28.589	----	28.589	----	28.589	----	28.989	33.972	-116	33.857	----	33.857
70434	USE OF PRIOR YEAR BALANCES CS (SWP	-13.200	----	-13.200	----	-13.200	----	-13.200	-8.686	----	-8.686	----	-8.686
997898	TOTAL, SOUTHWESTERN O&M	15.389	----	15.389	----	15.389	----	15.389	25.172	-116	25.057	----	25.057
70809	EFFECT OF PRIVATIZATION- SWPA	----	----	----	----	----	----	----	----	----	----	----	----
70805	PRIV. - SALE OF ASSETS - SWPA(NON-AD	----	----	----	----	----	----	----	----	----	----	----	----
999476	TOTAL, SOUTHWESTERN O&M	15.389	----	15.389	----	15.389	----	15.389	25.172	-116	25.057	----	25.057
998000	SOUTHWESTERN CONT. FUND												
70600	SOUTHWESTERN POWER - CONT. FUND	----	----	----	----	----	----	----	----	----	----	----	----
998998	TOTAL, SOUTHWESTERN CONT. FUND	----	----	----	----	----	----	----	----	----	----	----	----

A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	CONF TRANSFER B/A	FY 1989 IN FY 90 STR B/A	CONF TRANSFER B/A	FY 1990 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	CONF TRANSFER B/A	FY 1990 IN FY 91 STR B/A
998200	WESTERN AREA O&M												
00005	POWER MARKETING - WAPA O&M	270.938	-2.268	268.666	------	268.666	------	288.660	291.233	-679	290.654	------	290.654
00011	USE OF PRIOR YEAR BALANCES	------	------	------	------	------	------	------	------	------	------	------	------
00016	GENERAL REDUCTION	------	------	------	------	------	------	------	------	------	------	------	------
00017	TRANSFER FROM BOI	2.485	------	2.485	------	2.485	------	2.484	3.564	------	3.564	------	3.564
998290	TOTAL, WESTERN AREA O&M	273.413	-2.268	271.145	------	271.145	------	271.145	294.797	-679	294.218	------	294.218
00006	EFFECT OF PRIVATIZATION- WAPA	------	------	------	------	------	------	------	------	------	------	------	------
00007	PRIV - SALE OF ASSETS - WAPA(WSM-AD	------	------	------	------	------	------	------	------	------	------	------	------
00000	TOTAL, WESTERN AREA POWER ADMINISTRA	273.413	-2.268	271.145	------	271.145	------	271.145	294.797	-679	294.218	------	294.218
998400	WESTERN AREA POWER - EMERGENCY FUND												
10015	WAPA EMERGENCY FUND	------	------	------	------	------	------	------	------	------	------	------	------
998490	TOTAL, WAPA EMERGENCY FUND	------	------	------	------	------	------	------	------	------	------	------	------
998600	COLORADO RIVER BASIN												
00010	COLORADO RIVER BASIN (WSM-ADB)	(84.000)	------	(84.000)	------	(84.000)	------	(84.000)	(99.000)	------	(99.000)	------	(99.000)
00014	EFFECT OF PRIVATIZATION- CRB	------	------	------	------	------	------	------	------	------	------	------	------
998690	TOTAL, COLORADO RIVER BASIN	------	------	------	------	------	------	------	------	------	------	------	------

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DEPARTMENT OF ENERGY
FY 1991 CONTROL TABLE
(DOLLARS IN THOUSANDS)

FY APPROPRIATION

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A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	COMP TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
995490	PERC SALARIES AND EXPENSES												
90810	OIL PIPELINE REGULATION	3.884	------	3.884	------	3.884	------	3.884	4.837	-57	3.980	------	3.980
90820	NATURAL GAS REGULATION	50.582	------	50.582	------	50.582	------	50.582	53.752	-753	52.999	------	52.999
90830	HYDRO POWER LICENSING	28.254	------	28.254	------	28.254	------	28.254	31.745	-444	31.301	------	31.301
90840	ELECTRIC POWER REGULATION	26.200	------	26.200	------	26.200	------	26.200	27.814	-378	26.438	------	26.438
90843	TOTAL, PERC	108.760	------	108.760	------	108.760	------	108.760	116.598	-1.682	114.918	------	114.918
90847	REVENUES	-108.760	------	-108.760	108.760	------	------	------	-116.598	1.682	-114.918	114.918	------
90888	TOTAL, P E R C	------	------	------	108.760	108.760	------	108.760	------	------	------	114.918	114.918
995490	TOTAL, PERC SALARIES AND EXPENSES	------	------	------	108.760	108.760	------	108.760	------	------	------	114.918	114.918

BASIC | DEPARTMENT OF ENERGY | BY APPROPRIATION

FY 1991 CONTINUING TABLE

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A/S CODE	ACCOUNT TITLE	FY 1989 COMPARABLE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	CURR TRANSFER B/A	FY 1989 IN FY 91 STR B/A	CURR TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 COMPARABLE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	CURR TRANSFER B/A	FY 1990 IN FY 91 STR B/A
02060	NUCLEAR WASTE FUND												
02070	NUCLEAR WASTE FUND - OE	343.032	-3.000	340.032	------	340.032	------	340.032	356.000	-53.044	299.156	------	299.156
02080	USE OF PRIOR YEAR BALANCES	------	------	------	------	------	------	------	-4.000	------	-4.000	------	-4.000
02100	TOTAL - NUCLEAR WASTE FUND	343.032	-3.000	340.032	------	340.032	------	340.032	352.000	-53.044	295.156	------	295.156

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DEPARTMENT OF ENERGY
FY 1991 CONTROL TABLE
(DOLLARS IN THOUSANDS)

FY APPROPRIATION

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A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	CONF TRANSFER B/A	FY 1989 IN FY 91 $TB B/A	CONF TRANSFER B/A	FY 1989 IN FY 91 $TB B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	CONF TRANSFER B/A	FY 1990 IN FY 91 $TB B/A
996000	GEOTHERMAL RESOURCES												
70343	GEOTHERMAL RESOURCES DEVELOPMENT FU	75	------	75	------	75	------	75	75	-1	74	------	74
996000	TOTAL, GEOTHERMAL RESOURCES	75	------	75	------	75	------	75	75	-1	74	------	74
50644	CLEAN COAL TECHNOLOGY												
50645	CLEAN COAL TECHNOLOGY #1	------	------	------	------	------	------	------	------	------	------	------	------
50646	CLEAN COAL TECHNOLOGY #2	139.000	-2.200	187.000	------	187.000	------	187.000	135.000	------	135.000	------	135.000
50647	CLEAN COAL TECHNOLOGY #3	------	------	------	------	------	------	------	450.000	-31.000	419.000	------	419.000
50648	CLEAN COAL TECHNOLOGY #4	------	------	------	------	------	------	------	------	------	------	------	------
50649	CLEAN COAL TECHNOLOGY #5	------	------	------	------	------	------	------	------	------	------	------	------
50653	TOTAL, CLEAN COAL TECHNOLOGY	139.000	-2.200	187.000	------	187.000	------	187.000	585.000	-31.000	554.000	------	554.000

DEPARTMENT OF ENERGY
FY 1981 CONGRESSIONAL TABLE
(DOLLARS IN THOUSANDS)

BY APPROPRIATION

A/S CODE	ACCOUNT TITLE	FY 1979 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1980 ADJUSTED B/A	COMP TRANSFER B/A	FY 1981 IN FY 80 STR B/A	COMP TRANSFER B/A	FY 1981 IN FY 81 STR B/A	FY 1980 CONFERENCE B/A	ADJUSTED B/A	FY 1980 ADJUSTED B/A	COMP TRANSFER B/A	FY 1980 IN FY 81 STR B/A
9725.00	FOSSIL ENERGY												
50010	COAL												
50015	CONTROL TECHNOLOGY & COAL PREPARA												
50020	OP. EXP. & CAP. EQUIP	40.091	36	40.127	------	40.127	------	40.127	50.376	-761	57.615	------	57.615
50025	CONSTRUCTION	------	------	------	------	------	------	------	------	------	------	------	------
50030	TOTAL, CONTROL TECHNOLOGY & COAL	40.091	36	40.127	------	40.127	------	40.127	50.376	-761	57.615	------	57.615
50035	ADV. RESEARCH & TECHNOLOGY DEV												
50040	OP. EXP. & CAP. EQUIP	25.620	164	25.564	------	25.564	------	25.564	26.750	-360	26.390	------	26.390
50045	CONSTRUCTION	------	------	------	------	------	------	------	------	------	------	------	------
50050	TOTAL, ADV. RESEARCH & TECHNOLOGY	25.620	164	25.564	------	25.564	------	25.564	26.750	-360	26.390	------	26.390
50075	COAL LIQUEFACTION												
50080	OP. EXP. & CAP. EQUIP	31.961	928	32.889	------	32.889	------	32.889	34.982	-656	34.326	------	34.326
50085	CONSTRUCTION	------	------	------	------	------	------	------	------	------	------	------	------
50090	TOTAL, COAL LIQUEFACTION	31.961	928	32.889	------	32.889	------	32.889	34.982	-656	34.326		34.326
50095	COMBUSTION SYSTEMS												
50100	OP. EXP. & CAP. EQUIP	26.604	72	26.676	------	26.676	------	26.676	33.615	-438	33.177	------	33.177
50105	CONSTRUCTION	------	------	------	------	------	------	------	------	------	------	------	------
50110	TOTAL, COMBUSTION SYSTEMS	26.604	72	26.676	------	26.676	------	26.676	33.615	-438	33.177	------	33.177
50120	FUEL CELLS												
50125	OP. EXP. & CAP. EQUIP	26.534	------	26.534	------	26.534	------	26.534	38.581	-582	37.999	------	37.999
50130	CONSTRUCTION	------	------	------	------	------	------	------	------	------	------	------	------
50135	TOTAL, FUEL CELLS	26.534	------	26.534	------	26.534	------	26.534	38.581	-582	37.999	------	37.999
50140	MHD ENGINES												
50145	OP. EXP. & CAP. EQUIP	22.033	-674	22.358	------	22.358	------	22.358	21.219	-277	20.942	------	20.942
50150	CONSTRUCTION	------	------	------	------	------	------	------	------	------	------	------	------
50155	TOTAL, MHD ENGINES	22.033	-674	22.358	------	22.358	------	22.358	21.219	-277	20.942	------	20.942
50160	UNDERGROUND COAL GASIFICATION												
50165	OP. EXP. & CAP. EQUIP	1.371	------	1.371	------	1.371	------	1.371	826	-11	815	------	815
50170	CONSTRUCTION	------	------	------	------	------	------	------	------	------	------	------	------
50175	TOTAL, UNDERGROUND COAL GASIFICAT	1.371	------	1.371	------	1.371	------	1.371	826	-11	815	------	815

A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	COMP TRANSFER IN FY 91 STR B/A	FY 1989 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
50184	MAGNETOHYDRODYNAMICS												
50185	OP. EXP. & CAP. EQUIP.	37.000	------	37.000	------	37.000	------	37.000	40.900	-533	40.367	------	40.367
50190	CONSTRUCTION	------	------	------	------	------	------	------	------	------	------	------	------
50195	TOTAL, MAGNETOHYDRODYNAMICS	37.000	------	37.000	------	37.000	------	37.000	40.900	-533	40.367	------	40.367
50200	SURFACE COAL GASIFICATION												
50205	OP. EXP. & CAP. EQUIP.	21.557	------	21.557	------	21.557	------	21.557	23.737	-309	23.428	------	23.428
50210	CONSTRUCTION	------	------	------	------	------	------	------	------	------	------	------	------
50215	TOTAL, SURFACE COAL GASIFICATION	21.557	------	21.557	------	21.557	------	21.557	23.737	-309	23.428	------	23.428
50230	SUBTOTAL, COAL	241.795	500	242.295	------	242.295	------	242.295	278.884	-3.635	275.249	------	275.249
50231	FOSSIL ENERGY ENVIRONMENTAL RESTO												
50232	OP. EXP. & CAP. EQUIP.	------	------	------	------	------	------	------	1.843	-14	1.829	------	1.829
50233	CONSTRUCTION	------	------	------	------	------	------	------	------	------	------	------	------
50234	TOTAL, FOSSIL ENERGY ENVIRONMENTA	--	--	--	------	--	------	--	1.843	-14	1.829	------	1.829
50235	GAS												
50240	UNCONVENTIONAL GAS RECOVERY												
50245	OP. EXP. & CAP. EQUIP.	11.884	------	11.884	------	11.884	------	11.884	14.620	-191	14.429	------	14.429
50250	CONSTRUCTION	------	------	------	------	------	------	------	------	------	------	------	------
50255	TOTAL, UNCONVENTIONAL GAS RECOVER	11.884	------	11.884	------	11.884	------	11.884	14.620	-191	14.429	------	14.429
50270	SUBTOTAL - GAS	11.884	------	11.884	------	11.884	------	11.884	14.620	-191	14.429	------	14.429

A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	OSMP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	OSMP TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	OSMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
50270	PETROLEUM R&D												
50280	ADVANCED EXTRACTION AND PROCESS T												
50285	OP. EXP. & CAP. EQUIP	4.291	------	4.291	------	4.291	------	4.291	3.696	-67	3.583	------	3.583
50290	CONSTRUCTION	------	------	------	------	------	------	------	------	------	------	------	------
50295	TOTAL, ADVANCED PROCESS TECHNOLOG	4.291	------	4.291	------	4.291	------	4.291	3.696	-67	3.583	------	3.583
50320	ENHANCED OIL RECOVERY												
50325	OP. EXP. & CAP. EQUIP	23.983	------	23.983	------	23.983	------	23.983	27.767	-561	27.966	------	27.966
50330	CONSTRUCTION	------	------	------	------	------	------	------	------	------	------	------	------
50335	TOTAL, ENHANCED OIL RECOVERY	23.983	------	23.983	------	23.983	------	23.983	27.767	-561	27.966	------	27.966
50340	OIL SHALE												
50345	OP. EXP. & CAP. EQUIP	10.550	------	10.550	------	10.550	------	10.550	9.133	-119	9.014	------	9.014
50350	CONSTRUCTION	------	------	------	------	------	------	------	------	------	------	------	------
50355	TOTAL, OIL SHALE	10.550	------	10.550	------	10.550	------	10.550	9.133	-119	9.014	------	9.014
50370	SUBTOTAL PETROLEUM	38.824	------	38.824	------	38.824	------	38.824	40.596	-527	39.913	------	39.913

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DEPARTMENT OF ENERGY
FY 1991 CONGRESSIONAL BUDGET REQUEST
(DOLLARS IN THOUSANDS)

BY APPROPRIATION

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A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1991 IN FY 90 STR B/A	COMP TRANSFER B/A	FY 1991 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
54400	PROGRAM DIRECTION AND MANAGEMENT SU												
54405	HEADQUARTERS PROGRAM DIRECTION	16.297	-2.700	13.597	-----	13.597	-----	13.597	16.439	-216	16.225	-----	16.225
54410	ETC PROGRAM DIRECTION	50.621	-----	50.621	-----	50.621	-----	50.621	52.481	-684	51.797	-----	51.797
54412	FEDERAL INSPECTOR FOR THE ALASKA G	249	-----	249	-----	249	-----	249	249	-3	246	-----	246
54413	TOTAL, PROGRAM DIRECTION & MANAGEME	67.277	-2.700	64.577	-----	64.577	-----	64.577	69.169	-901	68.268	-----	68.268
54414	PLANT & CAPITAL EQUIPMENT												
54415	CAPITAL EQUIPMENT	980	-----	980	-----	980	-----	980	1.980	-30	1.480	-----	1.480
54420	CONSTRUCTION	21.280	-----	21.280	-----	21.280	-----	21.280	10.696	-139	10.557	-----	10.557
54425	TOTAL, PLANT & CAPITAL EQUIPMENT	21.780	-----	21.780	-----	21.780	-----	21.780	12.196	-169	12.027	-----	12.027
54426	FUELS CONVERSION: NATURAL GAS & ELE	-----	-----	-----	-----	-----	2.704	2.704	2.648	-35	2.613	102	2.715
54427	COOPERATIVE R&D	-----	-----	-----	-----	-----	-----	-----	4.691	-61	4.631	-----	4.631
54467	TOTAL, FOSSIL ENERGY	884.616	-2.194	870.321	-----	870.321	2.704	881.025	423.692	-6.523	416.169	102	418.271
54471	USE OF UNOBLIGATED BALANCES - FE (	-1.000	-----	-1.000	-----	-1.000	-----	-1.000	-1.000	-----	-1.000	-----	-1.000
54500	EMPLOYMENT FLOORS	1.000	-1.000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
54510	TOTAL, FOSSIL ENERGY	884.616	-3.194	877.321	-----	877.321	2.704	880.025	422.692	-6.523	416.169	102	416.641
992591	TOP, EXP, & CAP, EQUIP.)	863.336	-3.274	856.071	-----	856.071	2.704	858.775	411.996	-5.886	406.982	102	406.884
992592	(CONSTRUCTION)	21.280	-----	21.250	-----	21.250	-----	21.250	10.696	-139	10.557	-----	10.557

A/S CODE	ACCOUNT TITLE	FY 1989 COMPARABLE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	COMP TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 COMPARABLE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
89X8934	NAVAL PETROLEUM AND OIL SHALE RESERV												
5A4E4	NAVAL PETROLEUM AND OIL SHALE RESER	105.071	------	105.071	------	105.071	------	105.071	202.124	-2.605	199.519	------	199.519
5A4TJ	USE OF PRIOR YEAR BALANCES-NPR	------	------	------	------	------	------	------	-10.000	------	-10.000	------	-10.000
8934	TOTAL NAVAL PETROLEUM AND OIL SHALE	105.071	------	105.071	------	105.071	------	105.071	192.124	-2.605	189.519	------	189.519
5A911	EFFECT OF REIAPTIATION- NPR	------	------	------	------	------	------	------	------	------	------	------	------

BUDGET — DEPARTMENT OF ENERGY — FY 1991 CONTROL TABLE — BY APPROPRIATION

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A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 BTR B/A	COMP TRANSFER B/A	FY 1991 IN FY 91 BTR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 BTR B/A
99A003	CONSERVATION												
70364	TRANSPORTATION	54.504	-254	54.330	———	54.330	———	54.330	55.404	-727	54.757	———	54.757
70359	INDUSTRIAL	39.442	-171	39.291	———	39.287	———	39.287	51.155	-567	50.064	———	50.064
70369	BUILDINGS AND COMMUNITY SYSTEMS	32.647	-42	32.605	———	32.605	3.065	35.605	34.321	-401	33.922	2.044	35.968
70375	MULTI-SECTOR	32.357	-157	32.259	———	32.259	———	32.254	34.415	-403	34.012	———	34.012
70370	FACILITIES	13.000	———	13.000	———	13.000	———	13.000	———	———	———	———	———
70376	POLICY AND MANAGEMENT - CBIEC	2.664	-879	1.785	———	1.785	———	1.785	3.581	-31	3.464	———	3.464
70381	SUBTOTAL, CONSERVATION RESEARCH AND	165.734	-1.475	164.259	———	164.259	3.065	167.259	179.362	-2.137	177.223	2.044	179.067
70382	STATE AND LOCAL	211.195	———	211.195	———	211.195	———	211.195	219.905	-2.435	217.465	———	217.465
0 *	SUBTOTAL ENERGY CONSERVATION	376.929	-1.475	375.454	———	375.454	3.065	378.454	399.267	-4.572	394.689	2.044	396.532
70414	USE OF PRIOR YEAR BALANCES, EC	-4.427	———	-4.427	———	-4.427	———	-4.427	———	———	———	———	———
70755	PETROLEUM OVERCHARGE (PODRA)	-57.218	———	-57.218	———	-57.218	———	-57.218	-60.414	———	-60.414	———	-60.414
99A099	TOTAL, ENERGY CONSERVATION	315.284	-1.475	313.809	———	313.809	3.065	316.809	338.853	-4.572	334.275	2.044	336.118

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(DOLLARS IN THOUSANDS)

A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	CSRP TRANSFER B/A	IN FY 90 STR B/A	CSRP TRANSFER	IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	CSRP TRANSFER B/A	IN FY 91 STR B/A
995200	ECONOMIC REGULATION												
100010	FUELS CONVERSION	956	------	956	------	956	-956	------	------	------	------	------	------
100065	COMPLIANCE	12,511	------	12,511	------	12,511	------	12,511	11,674	------	11,674	------	11,674
100082	NATURAL GAS & ELECTRICITY	2,266	------	2,266	------	2,266	-2,266	------	------	------	------	------	------
100125	PROGRAM ADMINISTRATION	712	------	712	------	712	-83	629	791	------	791	-102	689
100405	OFFICE OF HEARINGS AND APPEALS	5,500	------	5,500	------	5,500	------	5,500	5,065	------	5,065	------	5,065
995299	TOTAL, ECONOMIC REGULATION	21,372	------	21,372	------	21,372	-2,704	18,668	18,500	------	18,500	-102	18,198

DEPARTMENT OF ENERGY
FY 1991 CONTROL TABLE
(DOLLARS IN THOUSANDS)

BY APPROPRIATION

A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 IN FY 90 $79 B/A	COMP TRANSFER B/A	FY 1989 IN FY 91 $79 B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 IN FY 91 $79 B/A
995205	EMERGENCY PREPAREDNESS												
140205	ENERGY EMERGENCIES	6,154	------	6,154	------	6,154	------	6,154	6,841	-98	6,551	------	6,551
995210	TOTAL, EMERGENCY PREPAREDNESS	6,154	------	6,154	------	6,154	------	6,154	6,841	-98	6,551	------	6,551

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DEPARTMENT OF ENERGY
FY 1991 CONTROL TABLE
(DOLLARS IN THOUSANDS)

BY APPROPRIATION

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A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	COMP TRANSFER B/A	FY 1989 1n FY 90 STD B/A	COMP TRANSFER B/A	FY 1989 1n FY 91 STD B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	COMP TRANSFER B/A	FY 1990 1n FY 91 STD B/A
50655	STRATEGIC PETROLEUM RESERVE												
50656	STRATEGIC PETROLEUM RESERVE	173.621	-----	173.621	-----	173.621	-----	173.621	194.009	-2.516	192.481	-----	192.481
50658	SUBTOTAL, STRATEGIC PETROLEUM RESERV	173.621	-----	173.621	-----	173.621	-----	173.621	194.009	-2.516	192.481	-----	192.481
996688	STRATEGIC PETROLEUM ACCOUNT												
50662	STRATEGIC PETROLEUM	262.000	-----	262.000	-----	262.000	-----	262.000	327.820	116.695	366.315	-----	366.315
50661	FY 1990 FINANCING FOR ADV. SPR OIL	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
50663	ADVANCE APPROPRIATION	-----	-----	-----	-----	-----	-----	-----	91.555	-----	91.555	-----	91.555
50664	FY 1990 ADVANCE APPROP (NON-ADD)	(91.555)	-----	(91.555)	-----	(91.555)	-----	(91.555)	-----	-----	-----	-----	-----
50665	FY 1991 TO FY 1995 ADVANCE APPROP	-----	-----	-----	-----	-----	-----	-----	(188.650)	-----	(188.650)	-----	(188.650)
50666	SUBTOTAL, STRATEGIC PETROLEUM ACCOUN	262.000	-----	262.000	-----	262.000	-----	262.000	419.375	116.695	458.065	-----	458.065

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DEPARTMENT OF ENERGY
FY 1991 CONTROL TABLE
(DOLLARS IN THOUSANDS)

BY APPROPRIATION

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A/S CODE	ACCOUNT TITLE	FY 1989 CONFERENCE B/A	ADJUSTMENTS B/A	FY 1989 ADJUSTED B/A	OSMP TRANSFER B/A	FY 1989 IN FY 90 STR B/A	OSMP TRANSFER B/A	FY 1989 IN FY 91 STR B/A	FY 1990 CONFERENCE B/A	ADJUSTED B/A	FY 1990 ADJUSTED B/A	OSMP TRANSFER B/A	FY 1990 IN FY 91 STR B/A
994888	ENERGY INFORMATION ACTIVITIES												
110481	NATIONAL ENERGY INFORMATION SYSTEM:												
110482	OIL AND GAS	13.306	-----	13.306	-----	13.306	-----	13.306	13.603	-297	13.306	-----	13.306
110484	COAL, NUCLEAR, ELECTRIC AND ALTERNA	4.916	-----	4.916	-----	4.916	-----	4.916	5.373	-157	5.216	-----	5.216
110486	ENERGY MARKETS AND END USE	5.238	-----	5.238	-----	5.238	-----	5.238	5.355	-135	5.220	-----	5.220
110488	AUTOMATED DATA PROCESSING SERVICES	6.683	-----	6.683	-----	6.683	-----	6.683	7.147	-124	7.023	-----	7.023
110815	ENERGY INFORMATION CENTER	680	-----	680	-----	680	-----	680	725	-26	699	-----	699
110912	STATISTICAL STANDARDS	1.130	-----	1.130	-----	1.130	-----	1.130	1.202	-97	1.105	-----	1.105
110914	PROGRAM DIRECTION/PERS	21.825	-----	21.825	-----	21.825	-----	21.825	21.777	-----	21.777	-----	21.777
110916	SUBTOTAL, NATIONAL ENERGY INFORMATI	52.798	-----	52.798	-----	52.798	-----	52.798	55.381	-776	54.505	-----	54.505
110918	POLICY AND MANAGEMENT	10.058	-----	10.058	-----	10.058	-----	10.058	9.981	-137	9.816	-----	9.816
994898	TOTAL, ENERGY INFORMATION ACTIVITIES	62.856	-----	62.856	-----	62.856	-----	62.856	65.232	-913	64.319	-----	64.319

ADJ WK1(baf)

ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

	FY 1989 ADJUSTED	FY 1990 ADJUSTED
ENERGY SUPPLY R&D		
Solar Building Energy Sys - OE	(60)	(97)
	(60) A/	(56) H/
	0	(41) G/
Solar Building Energy Sys-P&CE	0	(2) H/
Photovoltaic Energy Systems-OE	(354)	(830)
	(354) A/	(479) H/
	0	(351) G/
Photovoltaic Energy Sys -P&CE	0	(13) H/
Solar Thermal Energy Sys - OE	(188)	(366)
	(188) A/	(211) H/
	0	(155) G/
Solar Thermal Energy Sys -P&CE	0	(2) H/
Biofuels Energy Systems - OE	(205)	(379)
	(205) A/	(219) H/
	0	(160) G/
Biofuels Energy Systems - P&CE	0	(11) H/
Wind Energy Systems - OE	(79)	(220)
	(79) A/	(127) H/
	0	(93) G/
Wind Energy Systems - P&CE	0	(3) H/
Ocean Energy Systems - OE	(35)	(98)
	(35) A/	(57) H/
	0	(41) G/
Ocean Energy Systems - P&CE	0	(1) H/
Int'l Solar Energy Program -OE	0	(26)
	0	(15) H/
	0	(11) G/
Solar Technology Transfer - OE	0	(44)
	0	(25) H/
	0	(19) G/

A/ Reprogramming #89-R-12 to provide funding for the FY 1989 Small Business Innovation Research (SBIR) program.
G/ Spread of General Reduction (ESRD)
H/ Gramm-Rudman-Hollings Reduction

ADJUSTMENTS TO THE
FY 1991 BUDGET
(S000)

ADJ.WK1(baf)

	FY 1989 ADJUSTED	FY 1990 ADJUSTED	
Solar Energy Research Inst-P&CE	0	(9) H/	
Program Support	0	(21)	
	0	(12) H/	
	0	(9) G/	
Resource Assessment - OE	0	(19)	
	0	(11) H/	
	0	(8) G/	
Program Direction, Other Solar Ener	216	(59)	
	176	0	Reprogramming #89-R-21 from Policy & Management, CRE to resolve a projected FY 1989 funding shortfall.
	40	0	Reprogramming #89-R-21 from Energy Storage Systems, OE to resolve a projected FY 1989 funding shortfall.
	0	(59) H/	
Geothermal - OE	(235)	(426)	
	(235) A/	(251) H/	
	0	(175) G/	
Geothermal - P&CE	0	(6) H/	
Electric Energy Systems - OE	0	(430)	
	0	(252) H/	
	0	(178) G/	
Energy Storage Systems - OE	(275)	(298)	
	(235) A/	(174) H/	
	(40)	0	Reprogramming #89-R-21 to Solar Energy Program Direction to resolve a projected FY 1989 funding shortfall.
	0	(124) G/	
Light Water Reactor - OE	(336)	(577)	
	(336) A/	(347) H/	
	0	(230) G/	
Advanced Reactor R&D - OE	(1,995)	(1,401)	
	(1,000)	0	Reprogramming #89-R-24 to Facilities, OE, to meet critical needs in the Nuclear Energy program.
	(995) A/	(806) H/	
	0	(595) G/	

A/ Reprogramming #89-R-12 to provide funding for the FY 1989 Small Business Innovation Research (SBIR) program.
G/ Spread of General Reduction (ESRD)
H/ Gramm-Rudman-Hollings Reduction

ADJ WK1(bal)

ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

	FY 1989 ADJUSTED	FY 1990 ADJUSTED	
Advanced Reactor R&D - P&CE	0	(28)	H/
Facilities - OE	6,501	(4,010)	
	2,268	0	Appropriation transfer #89-R-24 from Western Area Power Administration to meet critical needs in the NE program.
	2,000	0	Reprogramming #89-R-24 from Space Reactor Power Systems P&CE, to meet critical needs in the NE program.
	1,000	0	Reprogramming #89-R-24 from Space Reactor Power Systems OE, to meet critical needs in the NE program.
	1,000	0	Reprogramming #89-R-24 from Advanced Reactor, OE, to meet critical needs in the Nuclear Energy program.
	800	0	Reprogramming #89-R-24 from Advanced Radioisotope Power Systems, OE, to meet critical needs in the NE program.
	100	0	Reprogramming #89-R-24 from Advanced Radioisotope Power Systems, P&CE, to meet critical needs in the NE program.
	(967) A/	(2,290)	H/
	0	(1,720)	G/
Facilities - P&CE	0	(207)	H/
Adv Radioisotope Power Sys -OE	(1,043)	(423)	
	(800)	0	Reprogramming #89-R-24 to Facilities, OE to meet critical needs in the NE program.
	(243) A/	(423)	H/
Adv Radioisotope Power Sys-P&CE	(100)	(735)	
	(100)	0	Reprogramming #89-R-24 to Facilities, OE to meet critical needs in the NE program.
	0	(272)	H/
	0	(463)	G/
Space Reactor Power Sys - OE	14,586	(307)	
	15,586	0	Reprogramming #89-R-20 from plant and capital equipment to operating expenses due to a rescoping of the SP-100 Ground Engineering System project.
	(1,000)	0	Reprogramming #89-R-24 to Facilities, OE, to meet critical needs in the Nuclear Energy program.
	0	(307)	H/

A/ Reprogramming #89-R-12 to provide funding for the FY 1989 Small Business Innovation Research (SBIR) program.
G/ Spread of General Reduction (ESRD)
H/ Gramm Rudman Hollings Reduction

ADJ WK1(baf)

ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

	FY 1989 ADJUSTED	FY 1990 ADJUSTED	
Space Reactor Power Sys - P&CE	(17,586)	(436)	
	(15,586)	0	Reprogramming #89-R-20 from plant and capital equipment to operating expenses due to a rescoping of the SP-100 Ground Engineering System project.
	(2,000)	0	Reprogramming #89-R-24 to Facilities, OE, to meet critical needs in the Nuclear Energy program.
	0	(138) H/	
	0	(298) G/	
Program Direction	0	(123) H/	
Civilian Waste R&D - OE	0	(23)	
	0	(14) H/	
	0	(9) G/	
Nuc Energy Remedial Action-OE	(606)	(5,584)	
	(600) B/	(3,284) H/	
	(6) A/	(2,300) G/	
Nuc Energy Remedial Act - P&CE	0	(22) H/	
Envrn, Safety, & Health - OE	0	(2,622)	
	0	(1,546) H/	
	0	(1,076) G/	
Envrn, Safety, & Health - P&CE	0	(43) H/	
Biological & Envrn Res - OE	(3,258)	(6,284)	
	(2,650) A/	(3,964) H/	
	(608) B/	(2,320) G/	
Biological & Envrn Res - P&CE	0	(1,194)	
	0	(494) H/	
	0	(700) G/	
Magnetic Fusion - OE	(1,889)	(7,279)	
	(3,878) A/	(4,177) H/	
	2,800	0	Reprogramming #89-R-8 from Magnetic Fusion, P&CE to improve understanding of tokamak confinement.
	(811) B/	(3,102) G/	

A/ Reprogramming #89-R-12 to provide funding for the FY 1989 Small Business Innovation Research (SBIR) program.
B/ Spread of General Reduction (ESRD)
G/ Spread of General Reduction (ESRD)
H/ Gramm-Rudman-Hollings Reduction

ADJ WK1(hsf)

ADJUSTMENTS TO THE
FY 1991 BUDGET
(3000)

	FY 1989 ADJUSTED	FY 1990 ADJUSTED	
Magnetic Fusion - P&CE	(2,800)	(453)	
	(2,800)	0	Reprogramming 89V-R-8 to Magnetic Fusion, OE to improve understanding of tokamak confinement.
	0	(409)	H/
	0	(44)	G/
Basic Energy Sciences - OE	(6,548)	(12,140)	
	(5,274)	A/ (6,603)	H/
	(1,274)	B/ (5,537)	G/
Basic Energy Sciences - P&CE	0	(1,669)	H/
Energy Research Analyses - OE	(40)	(180)	
	(40)	A/ (54)	H/
	0	(126)	G/
Univ Res Instrumentation - OE	(62)	A/ (70)	H/
Univ & Science Education - OE	(326)	(608)	
	(269)	A/ (354)	H/
	(57)	B/ (252)	G/
Advisory & Oversight - PD	0	(47)	H/
Multi-Program Lab Fac - OE	0	(126)	H/
Multi-Program Lab Fac - P&CE	(10,145)	(1,114)	
	(10,000)	0	General Reduction, Multi-Program Lab. Fac.
	(145)	B/ (611)	H/
	0	(503)	G/
Multi-Program Lab Fac. Gen Red	10,000	0	
Small Business Innovation Res	33,104	A/ 0	
Liquified Gaseous Facility -OE	0	(25)	
	0	(15)	H/
	0	(10)	G/
In-House Energy Management -OE	0	(28)	H/
In-House Energy Mgmt P&CE	(88)	(598)	
	(88)	B/ (248)	H/
	0	(350)	G/

A/ Reprogramming 89V-R-12 to provide funding for the FY 1989 Small Business Innovation Research (SBIR) program.
B/ Spread of General Reduction (ESRD).
G/ Spread of General Reduction (ESRD).
H/ Gramm-Rudman-Hollings Reduction

ADJ WK1(hsf)

ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

	FY 1989 ADJUSTED		FY 1990 ADJUSTED		
Facilities Infrastructure - OE	0		(28)	H/	
Facilities Infrastructure-P&CE	0		(3)	H/	
Technical Info & Mgmt - OE	0		(194)	H/	
Technical Info & Mgmt - P&CE	0		(16)	H/	
Policy and Management - ER	0		(9)	H/	
Policy and Management - NE	0		(31)	H/	
Policy and Management - CE	(176)		(22)		
	(176)		0		Reprogramming #89-R-21 to Solar Energy Program Direction to resolve a projected FY 1989 funding shortfall.
	0		(22)	H/	
Use of Unoblg Balances (ESRD)	3,583	B/	0		
General Reduction (ESRD)	0		21,000	G/	
Total, Energy Supply R&D	19,561		(31,017)		
OE	50,280		(24,452)		
P&CE	(30,719)		(6,565)		
URANIUM ENRICHMENT					
Uranium Enrichment Act - OE	53,518		(17,637)		
	55,000		0		FY90 Supplemental to increase Enrichment Operations to satisfy customer requirements.
	(1,482)	A/	(17,637)	H/	
Uranium Enrichment Act - P&CE	0		(860)	H/	
Uranium Program Direction	0		(66)	H/	
Revenues	0		83,718		Adjustment to revenues, UE
Total, Uranium Enrichment	53,518		65,155		
OE	53,518		66,015		
P&CE	0		(860)		

A/ Reprogramming #89-R-12 to provide funding for the FY 1989 Small Business Innovation Research (SBIR) program.
B/ Spread of General Reduction(ESRD).
G/ Spread of General Reduction(ESRD).
H/ Gramm-Rudman-Hollings Reduction.

ADJ WK1(haf)

ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

	FY 1989 ADJUSTED	FY 1990 ADJUSTED
GENERAL SCIENCE		
High Energy Physics - OE	(12,841)	(16,489)
	(7,372) C/	(6,619) H/
	(5,469) A/	(9,870) G/
High Energy Physics - P&CE	0	(3,090)
	0	(1,709) H/
	0	(1,381) G/
SS Collider - OE	(2,415)	(966)
	(1,387) C/	(966) H/
	(1,028) A/	0
SS Collider - P&CE	0	(6,302)
	0	(2,126) H/
	0	(4,176) G/
Nuclear Physics - OE	(5,553)	(6,905)
	(3,188) C/	(2,832) H/
	(2,365) A/	(4,073) G/
Nuclear Physics - P&CE	0	(2,795)
	0	(1,295) H/
	0	(1,500) G/
GS - Program Direction	(53) C/	(55) H/
General Reduction	12,000 C/	21,000 G/
Total, General Science	(8,862)	(15,602)
OE	(8,862)	(3,415)
P&CE	0	(12,187)
ISOTOPE PRODUCTION & DIST		
Isotope Production	0	(227) H/
Total, Isotope Production	0	(227)

A/ Reprogramming #89-R-12 to provide funding for the FY 1989 Small Business Innovation Research (SBIR) program
C/ Spread of General Reduction (ER/GS)
G/ Spread of General Reduction (ESRD)
H/ Gramm-Rudman-Hollings Reduction

ADJ WK1(baf)

ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

	FY 1989 ADJUSTED	FY 1990 ADJUSTED	
ATOMIC ENERGY DEFENSE ACTIVITIES			
Research, Dev & Testing - OE	(14,000)	(23,651) H/	
Research, Dev & Testing - P&CE	(4,769)	(5,414) H/	
Nuc Directed Engy Weapons-P&CE	(655)	0	
Inertial Confinement Fus- P&CE	(308)	0	
Production & Surveillance - OE	0	(31,500) H/	
Production & Surveillance-P&CE	(4,917)	(6,711)	
	(4,418)	(6,711) H/	
	(499)	0	Reprogramming #89-R-27 to Security Investigations to provide funding for critical requirements for additional security investigations.
Program Direction - OE	0	(1,469) H/	
Program Direction - P&CE	0	(26) H/	
Materials Production - OE	131,414	110,178	
	139,003	(24,822) H/	
	(9,700)	0	Realignment of funds #89-R-34 to transfer operating funds to the Fuel Production Facility (FPF) construction project #85-D-145.
	6,300	0	Reprogramming #89-R-5 from Materials Production, P&CE to provide for completion of the Engineering Demonstration System for SIS deployment by December 1994.
	(2,189)	0	Reprogramming #89-R-27 to Security Investigations to provide funding for critical requirements for additional security investigations.
	(2,000)	0	Appropriation transfer #89-N-6 to establish the Defense Nuclear Facilities Safety Board.
	0	135,000 H/	

F/ Omnibus Defense Programs reprogramming, #89-R-17, to provide for restart of Savannah River (SR) reactors, SR contract transition, waste activities and WIPP roads.
H/ Gramm-Rudman-Hollings Reduction

ADJ.WK1(baf)

ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

	FY 1989 ADJUSTED	FY 1990 ADJUSTED	
Materials Production - P&CE	17,891	(7,559)	
	14,000	(7,559)	H/
	9,700	0	Realignment of funds #89-R-34 to transfer operating funds to the Fuel Production Facility (FPF) construction project #85-D-145.
	(6,300)	0	Reprogramming #89-R-5 to Materials Production, OE to provide for completion of the Engineering Demonstration System for SIS deployment by December 1994.
	491	0	F/
New Production Reactors - OE	35,000	(3,052)	
	35,000	0	Reprogramming #89-R-4 from New Production Reactors construction for development activities consistent with the Department's acquisition strategy.
	0	(3,052)	H/
New Production Reactors - P&CE	(35,000)	(1,500)	
	(35,000)	0	Reprogramming #89-R-4 to New Production Reactors, OE for development activities consistent with the Department's acquisition strategy.
	0	(1,500)	H/
Waste Trans & Site Mgmt-OE	55,400	(21,627)	F/ H/
Waste Trans & Site Mgmt-P&CE	627	(3,258)	F/ H/
Use of Prior Year AED Balances	43,000	0	F/
Verification & Cont Tech - OE	650	(2,387)	
	550	0	Reprogramming #89-R-13 from Nuclear Safeguards and Security, OE, for technology exchange activities.
	300	0	Reprogramming #89-R-25 from capital equipment funds to operating expenses to support newly identified intelligence initiatives.
	(200)	0	Reprogramming #89-R-27 to Security Investigations to provide funding for critical requirements for additional security investigations.
	0	(2,387)	H/

F/ Omnibus Defense Programs reprogramming, #89-R-17, to provide for restart of Savannah River (SR) reactors, SR contract transition, waste activities and WIPP roads.
H/ Gramm-Rudman-Hollings Reduction

ADJ.WK1(baf)

ADJUSTMENTS TO THE FY 1991 BUDGET ($000)

	FY 1989 ADJUSTED	FY 1990 ADJUSTED	
Verification & Cont Tech -P&CE	(614)	(161)	
	(314) F/	(161) H/	
	(300)	0	Reprogramming #89-R-25 from capital equipment funds to operating expenses to support newly identified intelligence initiatives.
Nuc Safeguards & Security -OE	(950)	(1,234)	
	(550)	(1,234) H/	Reprogramming #89-R-13 to Verification & Control Technology, OE, for technology exchange activities.
	(400)	0	Reprogramming #89-R-27 to Security Investigations to provide funding for critical requirements for additional security investigations.
Nuc Safeguards & Security-P&CE	(180) F/	(75) H/	
Security Investigations - OE	3,288	(618)	
	3,288	0	Reprogramming #89-R-27 to Security Investigations to provide funding for critical requirements for additional security investigations.
	0	(618) H/	
Naval Reactors - OE	0	(8,441) H/	
Naval Reactors - P&CE	0	(1,336) H/	
Use of PY Funds (Omnibus Reprog)	(227,877) F/	0	
Total, Atomic Energy	(2,000)	(9,841)	
OE	25,925	16,199	
P&CE	(27,925)	(26,040)	

F/ Omnibus Defense Programs reprogramming, #89-R-17, to provide for restart of Savannah River (SR) reactors, SR contract transition, waste activities and WIPP roads.

H/ Gramm-Rudman-Hollings Reduction

ADJ.WK1(baf)

ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

	FY 1989 ADJUSTED	FY 1990 ADJUSTED
DEPARTMENTAL ADMINISTRATION		
Office of the Secretary	502	1,905
	502 D/	1,932 D/
	0	(27) H/
Board of Contract Appeals	(29)	73
	(29) D/	78 D/
	0	(5) H/
General Counsel	252	1,034
	252 D/	1,171 D/
	0	(137) H/
Inspector General - OE	1,867 D/	0
Inspector General - P&CE	(298) D/	0
Management & Admin - OE	9,974	8,129
	9,974 D/	10,128 D/
	0	(1,999) H/
Management & Admin - P&CE	608	463
	608 D/	488 D/
	0	(25) H/
Operations Offices - OE	6,161	(1,505)
	6,161 D/	(89) D/
	0	(1,416) H/
Operations Offices - P&CE	(134)	(136)
	(134) D/	(119) D/
	0	(17) H/
Minority Economic Impact - OE	(2,885)	2,970
	(2,885) D/	3,023 D/
	0	(53) H/
Policy Analysis & Sys Stud-OE	(495)	2,350
	(495) D/	2,430 D/
	0	(80) H/

D/ Use of Unobligated Balances
H/ Gramm-Rudman-Hollings Reduction

ADJ.WK1(baf)

ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

	FY 1989 ADJUSTED		FY 1990 ADJUSTED		
Congressional, Intergov. Aff, Program Direction	789		1,796		
	789	Dr	1,855	Dr	
	0		(59)	Hr	
Indian Affairs	309	Dr	0		
Consumer Affairs	(33)	Dr	(1)	Hr	
Public Affairs	(219)	Dr	(3)	Hr	
Competition	(50)	Dr	(1)	Hr	
International Affairs	83		988		
	83	Dr	1,062	Dr	
	0		(74)	Hr	
Cost of Work For Others	0		(1,074)	Hr	
Revenues Associates with COW	0		2,100	Hr	
Other Revenues	68,883		0		Reflects actual revenues
Use of Unoblig Balances (PPA)	495	Dr	(2,430)	Dr	
Use of Unoblig Balances (IA)	(83)	Dr	(1,062)	Dr	
Use of Unoblig Balances (MA)	(10,582)	Dr	(10,616)	Dr	
Use of Unoblig Balances (GC)	(252)	Dr	(1,171)	Dr	
Use of Unoblig Balances (BCA)	29	Dr	(78)	Dr	
Use of Unoblig Balances (OSEC)	(502)	Dr	(1,932)	Dr	
Use of Unoblig Balances (IG)	(1,569)	Dr	0		
Use of Unoblig Balances (CP)	(796)	Dr	(1,855)	Dr	
Use of Unoblig Balances (OMEI)	2,885	Dr	(3,023)	Dr	
Use of Unoblig Balances (OPS)	(6,027)	Dr	208	Dr	
Total, Departmental Admin	68,883		(2,871)		
OE	68,707		(3,198)		
P&CE	176		327		

D/ Use of Unobligated Balances
H/ Gramm-Rudman-Hollings Reduction

ADJ.WK1(baf)

ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

	FY 1989 ADJUSTED	FY 1990 ADJUSTED	
OFFICE OF INSPECTOR GENERAL			
Inspector General - OE	0	2,979	
	0	3,300	D/
	0	(321)	H/
Use of Unobligated Balances	0	(3,300)	D/
Total, Office of the IG	0	(321)	
ALASKA POWER ADMIN			
Power Marketing - O&M	0	(11)	H/
Total, Alaska Power	0	(11)	
BONNEVILLE POWER ADMIN			
Power Marketing	(51,683)	0	Reflects cash reserve unspent from FY 89 appropriation.
Total, Bonneville Power	(51,683)	0	
SOUTHEASTERN POWER ADMIN			
Power Marketing - O&M	0	(13)	H/
Total, Southeastern Power	0	(13)	
SOUTHEASTERN CONTINUING FUND			
SE Continuing Fund	3,072	0	Reflects funds for emergency purchases of power.
Total, Southeastern Power	3,072	0	
SOUTHWESTERN POWER ADMIN			
Power Marketing - O&M	0	(115)	H/
Total, Southwestern Power	0	(115)	

D/ Use of Unobligated Balances.
H/ Gramm-Rudman-Hollings Reduction

ADJ.WK1(baf)

ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

	FY 1989 ADJUSTED	FY 1990 ADJUSTED	
WESTERN AREA POWER ADMIN			
Power Marketing - O&M	(2,268)	(579)	
	(2,268)	0	Appropriation transfer #89-R-24 to Facilities, OE, ESRD, to meet critical needs in the Nuclear Energy program.
	0	(579) H/	
Total, Western Area Power Adm	(2,268)	(579)	
FERC			
Oil Pipeline Regulation	0	(57) H/	
Natural Gas Regulation	0	(753) H/	
Hydro Power Licensing	0	(444) H/	
Electric Power Regulation	0	(378) H/	
Revenues	0	1,632	Reflects adjustment to revenues.
Total, FERC	0	0	
NUCLEAR WASTE FUND			
Nuclear Waste Fund	(3,000)	(50,844)	
	(3,000)	0	Transfer to the Office of the Negotiator and the Nuclear Waste and Technical Review Boards.
	0	(4,844) H/	
	0	(46,000) I/	
Total, Nuclear Waste Fund	(3,000)	(50,844)	
GEOTHERMAL RESOURCES			
Geothermal Resources Dev	0	(1) H/	
Total, Geothermal Resources	0	(1)	
CLEAN COAL TECHNOLOGY			
Clean Coal Technology, #2	(2,200) A/	0	
Clean Coal Technology, #3	0	(31,000) I/	
Total, Clean Coal Technology	(2,200)	(31,000)	

H/ Gramm-Rudman-Hollings Reduction
I/ Reduction for DOE's drug prevention effort.

ADJ WK1(baf)

ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

	FY 1989 ADJUSTED		FY 1990 ADJUSTED	
FOSSIL ENERGY				
Control Tech. & Coal Prep - OE	36	H/	(761)	H/
Adv. Research & Tech Dev - OE	144	H/	(348)	H/
Coal Liquefaction - OE	828	H/	(456)	H/
Combustion Systems - OE	72	H/	(438)	H/
Fuel Cells - OE	0		(502)	H/
Heat Engines - OE	(574)	A/	(277)	H/
Underground Coal Gas - OE	0		(11)	H/
Magnetohydrodynamics - OE	0		(533)	H/
Surface Coal Gasification - OE	0		(309)	H/
FE Environmental Rest - OE	0		(14)	H/
Unconventional Gas Recovery-OE	0		(191)	H/
Advanced Extraction - OE	0		(47)	H/
Enhanced Oil Recovery - OE	0		(361)	H/
Oil Shale - OE	0		(119)	H/
Program Direction & Mgmt, (HQS)	(2,700)		(901)	
Hdqs Program Direction	(2,700)	A/	(214)	H/
ETC Program Direction	0		(684)	H/
Fed Inspector for Alaska	0		(3)	H/
Plant & Capital Equipment - CE	0		(20)	H/
Plant & Capital Equipment-Consa	0		(139)	H/
Fuels Conversion, Natural Gas	0		(35)	H/
Cooperative R&D	0		(61)	H/
Employment Floors	(1,080)	H/	0	
Total, Fossil Energy	(3,274)		(5,523)	
OE & Capital Equipment	(3,274)		(5,384)	
Construction	0		(139)	

A/ Reprogramming #89-R-12 to provide funding for the FY 1989 Small Business Innovation Research (SBIR) program.
E/ Spread of Employment Floors (FE).
H/ Gramm-Rudman-Hollings Reduction

ADJ.WK1(baf)

ADJUSTMENTS TO THE
FY 1991 BUDGET
(3000)

	FY 1989 ADJUSTED	FY 1990 ADJUSTED	
NAVAL PETROLEUM RESERVES			
Naval Petroleum Reserves	0	(2,685) H/	
Total, Naval Petroleum Reserve	0	(2,685)	
CONSERVATION			
Transportation	(254)	(727)	
	(304) A/	(727) H/	
	50	0	Reprogramming #89-R-29 from the Policy & Management program to support continued automation of Conservation's Headquarters operations.
Industrial	(173) A/	(569) H/	
Buildings & Community Systems	(62)	(401)	
	(172) A/	(401) H/	
	110	0	Reprogramming #89-R-29 from the Policy & Management program to support continued automation of Conservation's Headquarters operations.
Multi-Sector	(107)	(403)	
	(157) A/	(403) H/	
	50	0	Reprogramming #89-R-29 from the Policy & Management program to support continued automation of Conservation's Headquarters operations.
Policy and Management - CE	(879)	(39)	
	(669) A/	(39) H/	
	(210)	0	Reprogramming #89-R-29 from the Policy & Management program to support continued automation of Conservation's Headquarters operations.
State and Local	0	(2,435) H/	
Total-Conservation	(1,475)	(4,574)	

A/ Reprogramming #89-R-12 to provide funding for the FY 1989 Small Business Innovation Research (SBIR) program.
H/ Gramm-Rudman-Hollings Reduction

ADJ.WK1(baf)

ADJUSTMENTS TO THE FY 1991 BUDGET ($000)

	FY 1989 ADJUSTED	FY 1990 ADJUSTED	
EMERGENCY PREPAREDNESS			
Energy Emergencies	0	(90)	H/
Total, Emergency Preparedness	0	(90)	
STRATEGIC PETROLEUM RESERVES			
Strategic Petroleum Reserves	0	(2,516)	H/
Total, Strategic Petroleum Res	0	(2,516)	
STRATEGIC PETROLEUM ACCOUNT			
Strategic Petroleum	0	116,490	
	0	120,000	Reflects expected excess NPR receipts.
	0	(3,510)	H/
Total, Strategic Petroleum Account	0	116,490	
ENERGY INFORMATION ACTIVITIES			
Oil and Gas	0	(297)	H/
Coal, Nuclear, Electric	0	(157)	H/
Energy Markets & End Use	0	(135)	H/
Automated Data Processing	0	(124)	H/
Energy Information Center	0	(26)	H/
Statistical Standards	0	(37)	H/
Policy and Management	0	(137)	H/
Total, Energy Information Act	0	(913)	
TOTAL ADJUSTMENTS, DOE	70,272	22,902	

H/ Gramm-Rudman-Hollings Reduction

26-Jan-90

COMPARABILITY ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

COMPS.WK1(baf)

	FY 1989 BA	FY 1990 BA	
ENERGY SUPPLY RESEARCH & DEVELOPMENT			
Solar Buildings Energy Systems - OE	(3,000)	(2,846)	FY91 transfer to Buildings and Community Systems, OE, CE to provide funding for work formerly done in Solar Buildings.
Biofuels Energy Systems - OE	600	99	FY91 transfer from Energy Storage Systems, OE to provide funding for the transfer of Chemical-Hydrogen Activity to Biofuels and Municipal Waste.
Electric Energy Systems - OE	750	145	FY91 transfer from Energy Storage Systems, OE, to provide funding for the transfer of Superconducting Magnetic Energy Storage to Electric Energy Systems.
Energy Storage Systems - OE	(1,350)	(244)	
	(750)	(145)	FY91 transfer to Electric Energy Systems, OE, to provide funding for the transfer of Superconducting Magnetic Energy Storage to Electric Energy Systems.
	(600)	(99)	FY91 transfer to Biofuels Energy Systems, OE to provide funding for the transfer of Chemical-Hydrogen Activity to Biofuels and Municipal Waste.
Advanced Reactor R&D - OE	(4,720)	0	FY90 transfer to Facilities, OE, to provide funding for Steam Generator Testing, CDE, MOTA, and Core Conversion activities.
Advanced Reactor R&D - P&CE	220	0	FY90 transfer from Facilities, OE, to provide funding for Steam Generator Testing, CDE, MOTA, and Core Conversion activities.
Facilities - OE	15,292	(5,250)	
	4,720	0	FY90 transfer from Advanced Reactor R&D, OE, to provide funding for Steam Generator Testing, CDE, MOTA, and Core Conversion activities.
	(220)	0	FY90 transfer to Advanced Reactor R&D, P&CE, to provide funding for Steam Generator Testing, CDE, MOTA, and Core Conversion activities.
	15,000	0	FY90 transfer from Space Reactor Power Systems, OE to fund irradiation and test charges.
Subtotal, FY 90 Comps	19,500	0	
	(4,208) A/	(5,250) A/	
Facilities - P&CE	(375) A/	(887) A/	

A/ FY 91 Comparability transfer to provide funding for the 5-Year Environmental Plan.

COMPARABILITY ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

COMPS.WK1(baf)

	FY 1989 BA	FY 1990 BA	
Advance Radioisotope Power Sys- OE	6,743	0	
	7,300	0	FY90 transfer from Space Reactor Power Systems, OE, to provide funding for RPSF and the TECS.
	(557) A/	0	
Advance Radioisotope Power Sys-P&C	2,700	0	FY90 transfer from Space Reactor Power Systems, P&CE, to provide funding for RPSF and the TECS.
Space Reactor Power Systems - OE	(22,349)	(44)	
	(15,000)	0	FY90 transfer to Facilities, OE, to fund irradiation and test charges.
	(7,300)	0	FY90 transfer to Advance Radioisotope Power Systems, OE, to provide funding for RPSF and the TECS.
Subtotal, FY 90 Comps	(22,300)	0	
	(49) A/	(44) A/	
Space Reactor Power Systems - P&CE	(2,700)	0	FY90 transfer to Advance Radioisotope Power Systems, P&CE to provide funding for RPSF and the TECS. provide funding for RPSF and the DIPS.
Nuclear Energy Remedial Action - OE	(251,594) A/	(231,416) A/	
Nuclear Energy Remedial Action-P&CE	(3,100) A/	(1,578) A/	
Environment, Safety & Health - OE	(3,000)	(2,838)	FY91 transfer to Policy & Management, NE to provide funding for the transfer of the Advisory Committee on Nuclear Safety function to Nuclear Energy.
Environment, Safety & Health - P&CE	0	(121)	FY91 transfer to Policy & Management, NE to provide funding for the transfer of the Advisory Committee on Nuclear Safety function to Nuclear Energy.
Biological & Environmental Res - OE	(4,939)	(3,909)	
	(890)	0	FY90 transfer to Isotope Production and Distribution, to provide funding for the new Isotope program (per OMB).
	(4,049) A/	(3,909) A/	
Biological & Environmental Res-P&CE	(35) A/	(1,385) A/	
Magnetic Fusion - OE	(1,904) A/	(2,759) A/	
Magnetic Fusion - P&CE	(248) A/	0	

A/ FY 91 Comparability transfer to provide funding for the 5-Year Environmental Plan.

COMPARABILITY ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

COMPS.WK1(baf)

	FY 1989 BA	FY 1990 BA	
Basic Energy Sciences - OE	(9,883)	(8,367)	
	(1,885)	0	FY90 transfer to Isotope Production and Distribution, to provide funding for the new Isotope program (per OMB).
	(7,998) A/	(8,367) A/	
Basic Energy Sciences - P&CE	(1,679) A/	(4,287) A/	
Multi-Program Lab. Facilities - OE	(8,770) A/	(8,874) A/	
Multi-Program Lab. Facilities - P&CE	(22,573) A/	(20,760) A/	
Policy & Management - NE	3,000	2,959	
	3,000	2,838	FY91 transfer from Environment, Safety, & Health, OE to provide funding for the transfer of the Advisory Committee on Nuclear Safety function to Nuclear Energy.
	0	121	FY91 transfer from Environment, Safety, & Health, P&CE to provide funding for the transfer of the Advisory Committee on Nuclear Safety function to Nuclear Energy.
Total, Energy Supply R&D	(312,914)	(292,362)	
OE	(285,124)	(263,344)	
P&CE	(27,790)	(29,018)	

ENVIRONMENTAL RESTORATION & WASTE

Corrective Activities (EM) - OE	14,662 A/	13,717 A/
Corrective Activities (EM) - P&CE	14,461 A/	19,538 A/
Corrective Activities (DP) - OE	8,347 A/	13,672 A/
Corrective Activities (DP) - P&CE	30,710 A/	60,809 A/
Corrective Activities (ER) - OE	687 A/	1,378 A/
Corrective Activities (ER) - P&CE	15,535 A/	14,645 A/
Corrective Activities (NE) - OE	452 A/	601 A/
Corrective Activities (NE) - P&CE	200 A/	394 A/
Environmental Restoration (EM) - OE	414,404 A/	650,539 A/

A/ FY 91 Comparability transfer to provide funding for the 5-Year Environmental Plan.

COMPARABILITY ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

COMPS.WK1(baf)

	FY 1989 BA		FY 1990 BA		
Environmental Restoration (EM)-P&CE	5,278	A/	6,290	A/	
Waste Management (EM) - OE	841,591	A/	1,020,091	A/	
Waste Management (EM) - P&CE	253,688	A/	227,612	A/	
Technology Development (EM) - OE	51,005	A/	180,134	A/	
Technology Development (EM) - P&CE	827	A/	3,347	A/	
Program Direction	5,500	A/	5,550	A/	
Total, Envrn Restoration & Waste	1,657,347		2,218,317		
OE	1,336,648		1,885,682		
P&CE	320,699		332,635		
URANIUM ENRICHMENT					
Uranium Enrichment Activities - OE	(50,997)		(73,242)		
	4,841		0		FY90 transfer from Uranium Enrichment Activities, P&CE to provide funding for the Environmental Restoration program.
	(55,838)	A/	(73,242)	A/	
Uranium Enrichment Activities - P&CE	(9,117)		(6,435)		
	(4,841)		0		FY90 transfer to Uranium Enrichment Activities, OE, to provide funding for the Environmental Restoration program.
	(4,276)	A/	(6,435)	A/	
Corrective Activities - OE	1,578	A/	5,122	A/	
Corrective Activities - P&CE	3,023	A/	2,415	A/	
Environmental Restoration - OE	46,180	A/	58,426	A/	
Waste Management - OE	8,080	A/	9,694	A/	
Waste Management - P&CE	1,253	A/	4,020	A/	
Revenues	(1,430,651)		0		FY90 transfer to Receipts, UE.
Total, Uranium Enrichment	(1,430,651)		0		
OE	(1,425,810)		0		
P&CE	(4,841)		0		

A/ FY 91 Comparability transfer to provide funding for the 5-Year Environmental Plan.

COMPARABILITY ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

COMPS.WK1(baf)

	FY 1989 BA	FY 1990 BA	
GENERAL SCIENCE			
High Energy Physics - OE	(86,854)	(3,395)	
	(84,000)	0	FY90 transfer to Superconducting Supercollider, OE, to provide funding for the new SSC program.
	(2,854) A/	(3,395) A/	
High Energy Physics - P&CE	(17,328)	(1,179)	
	(16,000)	0	FY90 transfer to Superconducting Supercollider, P&CE, to provide funding for the new SSC program.
	(1,328) A/	(1,179) A/	
Superconducting Super Collider - OE	84,522	838	
	84,000	0	FY 90 transfer from High Energy Physics, OE, to provide funding for the new SSC program.
	522	838	FY91 transfer from General Science Program Direction. Program Direction for SSC will be budgeted for in the SSC decision unit.
Superconducting Super Collider - P&CE	16,000	0	FY90 transfer from High Energy Physics, P&CE, to provide funding for the new SSC program.
Nuclear Physics - OE	(601) A/	(939) A/	
General Science Program Direction	(522)	(838)	FY91 transfer to Superconducting Super Collider, OE. Program direction for SSC will be budgeted for in the SSC decision unit.
Total, General Science	(4,783)	(5,513)	
OE	(3,455)	(4,334)	
P&CE	(1,328)	(1,179)	
ISOTOPE PRODUCTION AND DIST			
Isotope Production	16,243	0	
	13,468	0	FY90 transfer from Cost of Work for Others, DA, to provide funding for the new Isotope program.
	1,885	0	FY90 transfer from Basic Energy Sciences, OE, ES, to provide funding for the new Isotope program.
	890	0	FY90 transfer from Biological & Environmental Research, OE, ES, to provide funding for the new Isotope program.
Isotope Sales	(16,452)	0	FY90 transfer from Revenues Associated with Cost of Work for Others, DA to provide funding for the new Isotope program.
Total, Isotope Production & Dist	(209)	0	

A/ FY 91 Comparability transfer to provide funding for the 5-Year Environmental Plan.

COMPARABILITY ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

COMPS.WK1(baf)

	FY 1989 BA	FY 1990 BA	
ATOMIC ENERGY			
Research & Development & Testing-OE	353,783	(22,104)	
	222,254	0	FY90 transfer from Nuclear Directed Energy Weapons, OE to reflect Administration's position to combine R&D efforts and to allow maximum funding flexibility.
	155,530	0	FY90 transfer from Inertial Confinement Fusion, OE, to reflect Administration's position to combine R&D efforts and to allow maximum funding flexibility.
Subtotal, FY 90 Comps	**377,784**	**0**	
	(22,236) A/	(20,218) A/	
	(1,765)	(1,886)	FY91 transfer to Program Direction to fund operational functions and activities at the SAN Operations Office.
Subtotal, FY 91 Comps	**(24,001)**	**(22,104)**	
Research & Development & Test-P&CE	17,377	(22,690)	
	32,091	0	FY90 transfer from Nuclear Directed Energy Weapons, P&CE to reflect Administration's position to combine R&D efforts and allow maximum funding flexibility.
	7,932	0	FY90 transfer from Inertial Confinement Fusion, P&CE, to reflect Administration's position to combine R&D efforts and allow maximum funding flexibility.
Subtotal, FY 90 Comps	**40,023**	**0**	
	(22,646) A/	(22,690) A/	
Nuclear Directed Energy Weapons - OE	(222,254)	0	FY90 transfer to RD&T, OE, to reflect Administration's position to combine R&D efforts and to allow maximum funding flexibility.
Nuclear Directed Energy Weapons-P&C	(32,091)	0	FY90 transfer to RD&T, P&CE, to reflect Administration's position to combine R&D efforts and to allow maximum funding flexibility.
Inertial Confinement Fusion - OE	(155,530)	0	FY90 transfer to RD&T, OE, to reflect Administration's position to combine R&D efforts and to allow maximum funding flexibility.
Inertial Confinement Fusion - P&CE	(7,932)	0	FY90 trans to RD&T, P&CE, to reflect Admin's position to combine R&D efforts and allow max. funding flexibility.

A/ FY 91 Comparability transfer to provide funding for the 5-Year Environmental Plan.

COMPARABILITY ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

COMPS.WK1(baf)

	FY 1989 BA	FY 1990 BA	
Production and Surveillance - OE	(115,688) A/	(100,283) A/	
Production and Surveillance - P&CE	(22,717) A/	(34,362) A/	
Program Direction - DP	1,765	1,261	
	1,765	1,886	FY91 transfer from RD&T, OE, to fund operational functions and activities at the SAN Operations Office.
	0	(625) A/	
Materials Production - OE	(131,156)	(101,670)	
	(25,000)	0	FY90 transfer to New Production Reactors, OE, to provide funding for the New Production Reactors program.
	(106,156) A/	(101,670) A/	
Materials Production - P&CE	(61,300)	(67,199)	
	(35,000)	0	FY90 transfer to New Production Reactors, P&CE, to provide funding for the New Production Reactors program.
	(26,300) A/	(67,199) A/	
New Production Reactors - OE	25,000	0	FY90 transfer from Materials Production, OE, to provide funding for the New Production Reactors program.
New Production Reactors - P&CE	35,000	0	FY90 transfer from Materials Production, P&CE, to provide funding for the New Production Reactors program.
Waste Trans & Site Mgmt - OE	(811,028) A/	(1,395,463) A/	
Waste Trans & Site Mgmt - P&CE	(218,654) A/	(178,766) A/	
Verification & Control Tech - OE	0	(1,496) A/	
Nuclear Safeguards & Security - OE	0	(516) A/	
Total, Atomic Energy	(1,345,425)	(1,923,288)	
OE	(1,055,108)	(1,620,271)	
P&CE	(290,317)	(303,017)	

A/ FY 91 Comparability transfer to provide funding for the 5-Year Environmental Plan.

COMPARABILITY ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

COMPS.WK1(baf)

	FY 1989 BA	FY 1990 BA	
DEPARTMENTAL ADMINISTRATION			
Inspector General - OE	(22,528)	0	FY90 transfer to Inspector General, OE. Congress decided to have IG as a separate and independent appropriation per P.L. 100-504.
Congress. Intg. Affairs - Program Dir	(1,407)	(2,155)	FY91 transfer to Public Affairs, Program Direction to provide funding for the move of this program from Congressional, Intergovernmental Affairs.
Congress. Intg. Affairs - Public Affairs	(41)	(266)	FY91 transfer to Public Affairs, to provide funding for the move of this program from Congressional, Intergovernmental Affairs.
Public Affairs	41	266	FY91 transfer from Congressional, Intergovernmental Affairs, to provide funding for the move of the Public Affairs program from CIA.
Public Affairs - Program Direction	1,407	2,155	FY91 transfer from Congressional, Intergovernmental Affairs, Program Direction, to provide funding for the move of the Public Affairs program from CIA.
Cost of Work for Others	(13,468)	0	FY90 transfer to Isotope Production, IP&D, to provide funding for the new Isotope Production & Dist. program.
Revenues Associated with Cost of Work for Others	16,452	0	FY90 transfer to Isotope Sales, IP&D, to provide funding for the new Isotope Production & Distribution program.
Use of Unobligated Balances - (PA)	0	(776)	FY91 transfer to Use of Unobligated Balances (CP) associated with the move of Public Affairs from CIA.
Use of Unobligated Balances - (IG)	1,569	0	FY90 transfer to Inspector General, use of unobligated balances. Congress decided to have the IG as a separate and independent appropriation per P.L. 100-504.
Use of Unobligated Balances - (CP)	0	776	FY91 transfer from Use of Unobligated Balances (PA) associated with the move of Public Affairs from CIA.
Total, Departmental Administration	(17,975)	0	
OE	(17,975)	0	
CE	0	0	

COMPARABILITY ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

COMPS.WK1(baf)

	FY 1989 BA	FY 1990 BA	
OFFICE OF INSPECTOR GENERAL			
Inspector General - OE	22,528	0	FY90 transfer from Inspector General, OE, DA . Congress decided to have the IG as a separate and independent appropriation per P.L. 100-504.
Use of Unobligated Balances	(1,569)	0	FY90 transfer from Use of Unobligated Balances, DA. Congress decided to have the IG as a separate and independent appropriation per P.L. 100-504.
Total, Inspector General	20,959	0	
FERC			
Revenues	108,760	114,918	
	108,760	0	FY90 transfer to Receipts, FERC.
	0	114,918	FY91 transfer to Receipts, FERC.
Total, FERC	108,760	114,918	
FOSSIL ENERGY			
Fuels Conversion, Natural Gas and Electricity	2,704	102	
	2,265	0	FY91 transfer from Natural Gas & Electricity, ERA to provide funding for the transfer of regulatory-related functions to Fossil Energy.
	356	0	FY91 transfer from Fuels Conversion, ERA, to provide funding for the transfer of regulatory-related functions to Fossil Energy.
	83	102	FY91 transfer from Program Administration, ERA to provide funding for the transfer of regulatory-related functions to Fossil Energy.
Total, Fossil Energy	2,704	102	

COMPARABILITY ADJUSTMENTS TO THE
FY 1991 BUDGET
($000)

COMPS.WK1(baf)

	FY 1989 BA	FY 1990 BA	
CONSERVATION			
Buildings & Community Systems	3,000	2,846	FY91 transfer from Solar Buildings Energy Systems, OE, ESRD to provide funding for work formerly done in Solar Buildings.
Total, Energy Conservation	3,000	2,846	
ECONOMIC REGULATION			
Fuels Conversion	(356)	0	FY91 transfer to Fuels Conversion, Natural Gas and Electricity, FE to provide funding for the transfer of regulatory-related functions in Fossil Energy.
Natural Gas & Electricity	(2,265)	0	FY91 transfer to Fuels Conversion, Natural Gas and Electricity, FE to provide funding for the transfer of regulatory-related functions in Fossil Energy.
Program Administration	(83)	(102)	FY91 transfer to Fuels Conversion, Natural Gas and Electricity, FE to provide funding for the transfer of regulatory-related functions in Fossil Energy.
Total, Economic Regulation	(2,704)	(102)	

89SUMCOM.WK1(baf)

DEPARTMENT OF ENERGY
FY 1989 COMPARABILITY TABLE
SUMMARY BY APPROPRIATION
($000)

APPROPRIATION	FY 1989 ACTUAL 1/	FY 1989 ADJUST 2/	REVISED FY 1989 ACTUAL	FY 1989 COMP ADJUST 3/	FY 1989 COMP TO FY 1991 4/
Energy Supply R&D - OE	1,819,394	50,280	1,869,674	(285,124)	1,584,550
Energy Supply R&D - P&CE	322,932	(30,719)	292,213	(27,790)	264,423
Total, Energy Supply R&D	2,142,326	19,561 A/	2,161,887	(312,914) M/	1,848,973
Environmental Restoration - OE	0	0	0	1,336,648	1,336,648
Environmental Restoration -P&CE	0	0	0	320,699	320,699
Total, Envrn Restoration	0	0	0	1,657,347 N/	1,657,347
Uranium Enrichment - OE	1,106,600	53,518	1,160,118	(1,425,810)	(265,692)
Uranium Enrichment - P&CE	26,480	0	26,480	(4,841)	21,639
Total, Uranium Enrichment	1,133,080	53,518 B/	1,186,598	(1,430,651) O/	(244,053)
General Science - OE	714,916	(8,862)	706,054	(3,455)	702,599
General Science - P&CE	207,200	0	207,200	(1,328)	205,872
Total, General Science	922,116	(8,862) C/	913,254	(4,783) P/	908,471
Isotope Production & Distribution	0	0	0	(209) Q/	(209)
Atomic Energy Defense Activities -OE	6,660,925	25,925	6,686,850	(1,055,108)	5,631,742
Atomic Energy Defense Activities-P&CE	1,439,075	(27,925)	1,411,150	(290,317)	1,120,833
Total, Atomic Energy Defense	8,100,000	(2,000) D/	8,098,000	(1,345,425) R/	6,752,575
Departmental Administration - OE	155,778	68,707	224,485	(17,975)	206,510
Departmental Administration -P&CE	7,162	176	7,338	0	7,338
Total, Departmental Admin	162,940	68,883 E/	231,823	(17,975) S/	213,848
Office of the Inspector General	0	0	0	20,959 T/	20,959
Alaska Power Administration	3,159	0	3,159	0	3,159
Bonneville Power Administration	211,200	(51,683) F/	159,517	0	159,517
Southeastern Power Administration	36,267	0	36,267	0	36,267
SE Continuing Fund	0	3,072 G/	3,072	0	3,072
Southwestern Power Administration	15,389	0	15,389	0	15,389
Western Power Administration	273,413	(2,268) H/	271,145	0	271,145
Total, Power Marketing	539,428	(50,879)	488,549	0	488,549

DEPARTMENT OF ENERGY
FY 1989 COMPARABILITY TABLE
SUMMARY BY APPROPRIATION
($000)

APPROPRIATION	FY 1989 ACTUAL u/	FY 1989 ADJUST x/	REVISED FY 1989 ACTUAL	FY 1989 COMP ADJUST x/	FY 1989 COMP TO FY 1991 v/
Federal Energy Regulatory Comm	0	0	0	108,760 w/	108,760
Nuclear Waste Disposal Fund	369,832	(3,000) y/	366,832	0	366,832
Geothermal Resource Dev Fund	75	0	75	0	75
Subtotal, Energy & Water Dev	13,369,797	77,221	13,447,018	(1,324,891)	12,122,127
Clean Coal Technology - #2	190,000	(2,200) z/	187,800	0	187,800
Fossil Energy -OE & Capital Equip	359,345	(3,274)	356,071	2,704	358,775
Fossil Energy - Construction	21,250	0	21,250	0	21,250
Total, Fossil Energy	380,595	(3,274) aa/	377,321	2,704 ww/	380,025
Naval Petroleum & Oil Shale Res	185,071	0	185,071	0	185,071
Energy Conservation	315,284	(1,475) bb/	313,809	3,000 xx/	316,809
Economic Regulation	21,372	0	21,372	(2,704) yy/	18,668
Emergency Preparedness	6,154	0	6,154	0	6,154
Strategic Petroleum Reserve	173,421	0	173,421	0	173,421
Strategic Petroleum Account	242,000	0	242,000	0	242,000
Energy Information Administration	62,856	0	62,856	0	62,856
Subtotal, Interior	1,576,753	(6,949)	1,569,804	3,000	1,572,804
Subtotal, Energy & Water Dev	13,369,797	77,221	13,447,018	(1,324,891)	12,122,127
Subtotal, DOE	14,946,550	70,272	15,016,822	(1,321,891)	13,694,931
PERMANENT INDEFINITE APPROP					
Payments to States	2,249	0	2,249	0	2,249
TOTAL, DOE	14,948,799	70,272	15,019,071	(1,321,891)	13,697,180

FOOTNOTES

1/ Based on actuals as appropriated: P.L. 100-371 Energy and Water Development
P.L. 100-446 Interior & Related Agencies

2/ Reflects changes to the Appropriation such as amendments.

3/ Comparability Adjustments are made to present funds in the budget year structure (FY 1991). These adjustments do not affect the execution structure.

4/ Agrees with the current Statistical Table.

A/	17,293	FY 1989 SBIR, ESRD
	2,268	Appropriation transfer #89-R-24 from Western Area Power Administration to meet critical needs in the Nuclear Energy Program.
	19,561	Total Adjustment, Energy Supply R&D
B/	55,000	Supplemental to increase enrichment operations to satisfy customer requirements, UE.
	-1,482	FY 1989 SBIR, UE
	53,518	Total Adjustment, Uranium Enrichment
C/	-8,862	FY 1989 SBIR, General Science
D/	-2,000	Appropriation transfer #89-N-6 to establish the Defense Nuclear Facilities Safety Board, Atomic Energy Defense
E/	68,883	Reflects actual revenues, Departmental Administration.
F/	-51,683	Reflects cash reserve unspent from FY 89 appropriation.
G/	3,072	Reflects funds for emergency purchases of power.
H/	-2,268	Appropriation transfer #89-R-24 to Facilities, OE, Energy Supply R&D, to meet critical needs in the Nuclear Energy program, WAPA.

I/	-3,000	Transfer to the Office of the Negotiator and the Nuclear Waste and Technical Review Boards, NWDF.
J/	-2,200	FY 1989 SBIR, Clean Coal Technology
K/	-3,274	FY 1989 SBIR, Fossil Energy
L/	-1,475	FY 1989 SBIR, Conservation Energy
M/	-307,139	FY 1991 transfer to provide funding for the 5-year environmental plan.
	-3,000	FY 1991 transfer from Solar Buildings Energy Systems, OE, to Buildings and Community Systems, OE, CE to provide funding for work formerly done in Solar Buildings.
	-1,885	FY 1990 transfer from Basic Energy Sciences, OE to Isotope Production and Distribution, OE to provide funding for the new Isotope program (per OMB).
	-890	FY 1990 transfer from Biological and Environmental Research, OE, to Isotope Production and Dist, OE, to provide funding for the new Isotope program (per OMB).
	-312,914	Total Comparability Adjustment, ESRD
N/	1,657,347	FY 1991 transfer to provide funding for the 5-year environmental plan, Envrn Rest.
O/	-1,430,651	FY 1990 transfer to Receipts, UE
P/	-4,783	FY 1991 transfer to provide funding for the 5-year environmental plan, GS
Q/	-16,452	FY 1990 transfer to Isotope Sales, IPD, from Revenues Associated with Cost of Work for Others, DA to provide funding for the Isotope program
	13,468	FY 1990 transfer to Isotope Production, IPD, from Cost of Work for Others, DA, to provide funding for the Isotope program
	1,885	See footnote M/ above
	890	See footnote M/ above
	-209	Total Comparability Adjustment, Isotope Production & Distribution
R/	-1,345,425	FY 1991 transfer to provide funding for the 5-year environmental plan, AE.

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S/	-22,528	FY 1990 transfer to the Inspector General, OE, IG, from Inspector General, OE, DA. Congress decided to have the IG as a separate and independent appropriation per P.L. 100-504.
	16,452	See footnote Q/ above
	-13,468	See footnote Q/ above
	1,569	FY 1990 transfer to the Inspector General, OE, IG, from Use of Unobligated Balances, IG (DA). Congress decided to have the IG as a separate and Independent appropriation per P.L. 100-504.
	-17,975	Total Comparability Adjustment, Departmental Administration
T/	22,528	See footnote S/ above
	-1,569	See footnote S/ above
	20,959	Total Comparability Adjustment, Inspector General
U/	108,760	FY 1990 Comparability Transfer to Receipts, FERC
V/	2,265	FY 1991 Comparability Transfer from Natural Gas & Electricity, ERA to Fuels Conversion, Natrual Gas & Electricity, FE to provide funding for the transfer of regulatory-related functions to Fossil Energy
	365	FY 1991 Comparability Transfer from Fuels Conversion, ERA to Fuels Conversion, Natural Gas & Electricity, FE to provide funding for the transfer of regulatory-related functions to Fossil Energy
	83	FY 1991 Comparability Transfer from Program Administration, ERA to Fuels Conversion, Natural Gas & Electricity, FE to provide funding for the transfer of regulatory-related functions to Fossil Energy.
	2,704	FY 1990 Comparability Transfer to Receipts, FE
W/	3,000	See footnote M/ above
X/	-2,265	See footnote V/ above
	-356	See footnote V/ above
	-83	See footnote V/ above
	-2,704	FY 1990 Comparability Transfer to Receipts, Economic Regulation

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DEPARTMENT OF ENERGY
FY 1990 COMPARABILITY TABLE
SUMMARY BY APPROPRIATION
($000)

APPROPRIATION	FY 1990 ACTUAL u/	FY 1990 ADJUST v/	REVISED FY 1990 ACTUAL	FY 1990 COMP ADJUST w/	FY 1990 COMP TO FY 1991 x/
Energy Supply R&D - OE	1,909,294	(24,452)	1,884,842	(263,344)	1,621,498
Energy Supply R&D - P&CE	306,172	(6,565)	299,607	(29,018)	270,589
Total, Energy Supply R&D	2,215,466	(31,017) AA/	2,184,449	(292,362) Y/	1,892,087
Environmental Restoration-OE	0	0	0	1,885,682	1,885,682
Environmental Restoration-P&CE	0	0	0	332,635	332,635
Total, Envrn Restoration	0	0	0	2,218,317 W/	2,218,317
Uranium Enrichment - OE	(136,100)	66,015	(70,085)	0	(70,085)
Uranium Enrichment - P&CE	66,200	(860)	65,340	0	65,340
Total, Uranium Enrichment	(69,900)	65,155 BB/	(4,745)	0	(4,745)
General Science - OE	740,981	(3,415)	737,566	(4,334)	733,232
General Science - P&CE	373,450	(12,187)	361,263	(1,179)	360,084
Total, General Science	1,114,431	(15,602) CC/	1,098,829	(5,513) X/	1,093,316
Isotope Production & Distribution	16,243	(227) DD/	16,016	0	16,016
Atomic Energy Defense Activities -OE	7,920,026	16,199	7,936,225	(1,620,271)	6,315,954
Atomic Energy Defense Activities-P&CE	1,736,008	(26,040)	1,709,968	(303,017)	1,406,951
Total, Atomic Energy Defense	9,656,034	(9,841) EE/	9,646,193	(1,923,288) Y/	7,722,905
Departmental Administration - OE	201,783	(3,198)	198,585	0	198,585
Departmental Administration -P&CE	3,273	327	3,600	0	3,600
Total, Departmental Admin	205,056	(2,871) FF/	202,185	0	202,185
Office of the Inspector General	22,959	(321) GG/	22,638	0	22,638
Alaska Power Administration	3,145	(11) HH/	3,134	0	3,134
Bonneville Power Administration	258,200	0	258,200	0	258,200
Southeastern Power Administration	18,469	(13) II/	18,456	0	18,456
Southwestern Power Administration	25,172	(115) JJ/	25,057	0	25,057
Western Power Administration	294,797	(579) KK/	294,218	0	294,218
Total, Power Marketing	599,783	(718)	599,065	0	599,065
Federal Energy Regulatory Comm	0	0	0	114,918	114,918

DEPARTMENT OF ENERGY
FY 1990 COMPARABILITY TABLE
SUMMARY BY APPROPRIATION
($000)

APPROPRIATION	FY 1990 ACTUAL	FY 1990 ADJUST	REVISED FY 1990 ACTUAL	FY 1990 COMP ADJUST	FY 1990 COMP TO FY 1991
Nuclear Waste Disposal Fund	346,000	(50,844) L/	295,156	0	295,156
Geothermal Resource Dev Fund	75	(1) M/	74	0	74
Subtotal, Energy & Water Dev	14,106,147	(46,287)	14,059,860	112,072	14,171,932
Clean Coal Technology - #2	135,000	0	135,000	0	135,000
Clean Coal Technology - #3	450,000	(31,000)	419,000	0	419,000
Total, Clean Coal Technology	585,000	(31,000) N/	554,000	0	554,000
Fossil Energy -OE & Capital Equip	411,366	(5,384)	405,982	102	406,084
Fossil Energy - Construction	10,696	(139)	10,557	0	10,557
Total, Fossil Energy	422,062	(5,523) O/	416,539	102 Z/	416,641
Naval Petroleum & Oil Shale Res	192,124	(2,685) P/	189,439	0	189,439
Energy Conservation	372,646	(4,574) Q/	368,072	2,846 AA/	370,918
Economic Regulation	18,300	0	18,300	(102) BB/	18,198
Emergency Preparedness	6,641	(90) R/	6,551	0	6,551
Strategic Petroleum Reserve	194,999	(2,516) S/	192,483	0	192,483
Strategic Petroleum Account	319,375	116,490 T/	435,865	0	435,865
Energy Information Administration	65,232	(913) U/	64,319	0	64,319
Subtotal, Interior	2,176,379	69,189	2,245,568	2,846	2,248,414
Subtotal, Energy & Water Dev	14,106,147	(46,287)	14,059,860	112,072	14,171,932
Subtotal, DOE	16,282,526	22,902	16,305,428	114,918	16,420,346
PERMANENT INDEFINITE APPROP					
Payments to States	2,249	0	2,249	0	2,249
TOTAL, DOE	16,284,775	22,902	16,307,677	114,918	16,422,595

FOOTNOTES

1/ Based on the FY 1990 Conference Reports: 101-235 Energy and Water Development
101-264 Interior & Related Agencies

2/ Reflects changes to the Appropriation such as amendments.

3/ Comparability Adjustments are made to present funds in the budget year structure (FY 1991). These adjustments do not affect the execution structure.

4/ Agrees with the current Statistical Table.

A/ -31,017 FY 1990 Gramm-Rudman-Hollings Reduction, ESRD

B/ 83,718 Adjustment to revenues.
-18,563 FY 1990 Gramm-Rudman-Hollings Reduction, UE
65,155 Total Adjustment, UE.

C/ -15,602 FY 1990 Gramm-Rudman-Hollings Reduction, GS

D/ -227 FY 1990 Gramm-Rudman-Hollings Reduction, Isotope Production & Distribution

E/ -9,841 FY 1990 Gramm-Rudman-Hollings Reduction, AEDA

F/ -2,871 FY 1990 Gramm-Rudman-Hollings Reduction, DA

G/ -321 FY 1990 Gramm-Rudman-Hollings Reduction, IG

H/ -11 FY 1990 Gramm-Rudman-Hollings Reduction, Alaska Power Administration

I/ -13 FY 1990 Gramm-Rudman-Hollings Reduction, Southeastern Power Administration

J/ -115 FY 1990 Gramm-Rudman-Hollings Reduction, Southwestern Power Administration

K/	-579	FY 1990 Gramm-Rudman-Hollings Reduction, Western Power Administration
L/	-46,000	Reduction for DOE's drug prevention effort
	-4,844	FY 1990 Gramm-Rudman-Hollings Reduction
	-50,844	Total Adjustment, Nuclear Waste Disposal Fund
M/	-1	FY 1990 Gramm-Rudman-Hollings Reduction, GRDF
N/	-31,000	Reduction for DOE's drug prevention effort, CCT
O/	-5,523	FY 1990 Gramm-Rudman-Hollings Reduction, FE
P/	-2,685	FY 1990 Gramm-Rudman-Hollings Reduction, NPR
Q/	-4,574	FY 1990 Gramm-Rudman-Hollings Reduction, Energy Conservation
R/	-90	FY 1990 Gramm-Rudman-Hollings Reduction, Emergency Preparedness
S/	-2,516	FY 1990 Gramm-Rudman-Hollings Reduction, Strategic Petroleum Reserve
T/	120,000	Reflects expected excess NPR receipts.
	-3,510	FY 1990 Gramm-Rudman-Hollings Reduction, Strategic Petroleum Account
	116,490	Total Adjustment, Strategic Petroleum Account.
U/	-913	FY 1990 Gramm-Rudman-Hollings Reduction, EIA
V/	-289,516	FY91 Comparability Transfer to provide funding for the 5-Year Environmental Plan, ESRD.
	-2,846	FY91 Comparability Transfer from Solar Buildings Energy Systems, OE to Buildings and Community Systems, OE, CE to provide funding for work formerly done in Solar Buildings.
	-292,362	Total Comparability Adjustment, ESRD
W/	2,218,317	FY91 Comparability Transfer to provide funding for the 5-Year Environmental Plan, UE.
X/	-5,513	FY91 Comparability Transfer to provide funding for the 5-Year Environmental Plan, GS.

Y/	-1,923,288	FY91 Comparability Transfer to provide funding for the 5-Year Environmental Plan, AE.
Z/	102	FY91 Comparability Transfer from Program Administration, ERA to Fuels Conversion, Natural Gas and Electricity, FE to provide funding for the transfer of regulatory-related functions to Fossil Energy.
AA/	2,846	See Footnote V/ above.
BB/	-102	See Footnote Z/ above.

TABLE OF FOREIGN TRAVEL BY DEPARTMENT OF ENERGY EMPLOYEES

Mr. Bevill. Please provide a table showing all foreign travel by DOE personnel in FY 1989 and FY 1990 to date. Please provide this information by name of traveler, location and dates of travel and purpose of travel.

Mr. Easton. A table listing information on foreign travel by DOE personnel for FY 1989 and FY 1990 through February 1990, will be provided to the Committee as soon as it is available. The expenditure levels are expected to to be comparable with the FY 1988 level.

MANAGEMENT OF CONFERENCE ACTIVITIES

Mr. Bevill. Please provide a list of all conferences sponsored by DOE. Include the number of DOE people attending, location of conference and purpose.

Mr. Tarro. Conferences are held by Departmental organizations as an effective way of conducting business. In addition, numerous and frequent meetings involving small groups of headquarters, field and contractor personnel occur to discuss matters relevant to their programmatic responsibilities. We do not consider these to be conferences. However, to improve the overall management and control of conference activities throughout the Department, we have formalized our conference management process through the issuance of a DOE Order on Departmental Conference Activity, dated January 27, 1987. We will provide for the record a listing of those conferences conducted by the Department in fiscal year 1989 which were reported subject to the requirements of the Order. For consistency with the appropriation cycle, reporting of conferences is changed from calendar year to fiscal year. Consequently, conferences occurring during the period October thru December 1988 were also reported in last year's response.

(The information follows:)

DEPARTMENTAL CONFERENCE ACTIVITIES - FISCAL YEAR 1989

Listing of DOE-sponsored conferences subject to the reporting requirements of DOE Order 1130.7, DEPARTMENTAL CONFERENCE ACTIVITY.

Title/Purpose	Location	DOE Attendance*
7th Annual DOE Operations Security Workshop	Pinellas, Florida	35
DOE Laboratory Productivity Improvement Seminar	Oak Ridge, Tennessee	6
Fuel Cell Seminar	Long Beach, California	8
Coal Public Awareness Workshop	Gaithersburg, Maryland	30
Electricity Futures Symposium: Building Efficiently Toward Tomorrow	Portland, Oregon	43
Inspector General's Conference	Annapolis, Maryland	51
8th DOE Automated Office Support System Conference	Richland, Washington	16
National Weatherization State Manager's Conference	St. Louis, Missouri	47
26th Automotive Technology Development Contractor's Coordination Meeting	Dearborn, Michigan	11
Conference on the Science and Technology of Thin Film Superconductors	Colorado Springs, Colorado	3
Quality Assurance Research and Development Conference	San Francisco, California	39
Remedial Action Programs Annual Meeting	Gaithersburg, Maryland	48
DOE National Environmental Policy Act (NEPA) Compliance Workshop	Washington, DC	148
DOE/Contractor Micrographics and Information Management Association Workshop	Overland Park, Kansas	10
Office of Small and Disadvantaged Business Utilization National Conference	Pasco, Washington	55
Department-wide Equal Employment Opportunity Training Conference	Las Vegas, Nevada	165
DOE Cost Price Conference	Memphis, Tennessee	29

Title/Purpose	Location	DOE Attendance*
Real Property Management Conference	Albuquerque, New Mexico	73
DOE Committee for Cost Methods Development Meeting	Santa Fe, New Mexico	19
DOE Training Officers Conference	Washington, DC	39
Training Resource and Data Exchange Conference	San Francisco, California	12
Headquarters Budget Conference	Rockville, Maryland	131
Association for Energy Systems, Operations, and Programming (AESOP)	Berkeley, California	16
Engineering and Construction Conference	Las Vegas, Nevada	51
Records and Electronic Forms Workshop	Dallas, Texas	41
University Coal Research Peer Review	Pittsburgh, Pennsylvania	30
Power for the West: A Symposium on International Cooperation	Portland, Oregon	69
Western Procurement Conference	Tucson, Arizona	40
DOE 3rd Mail Management Conference	Mesa, Arizona	26
DOE/EEO Contractor's Conference	Knoxville, Tennessee	11
Scientific Technical Information Meeting	Oak Ridge, Tennessee	26
DOE 1989 Financial Management Conference	Phoenix, Arizona	86
Competition Advocates Meeting	Colorado Springs, Colorado	41
Personnel Officers Conference	Washington, DC	28
12th DOE Computer Security Group Conference	Amarillo, Texas	51
Association for Energy Systems, Operations, and Programming (AESOP)	Morgantown, West Virginia	50
West Virginia Small Enterprise/ Entrepreneurial Trade Fair	Morgantown, West Virginia	25
4th National Conference on Utility Demand-Side Management	Cincinnati, Ohio	26
Property Management Conference	Phoenix, Arizona	26

Title/Purpose	Location	DOE Attendance*
Financial Management System (FMS) Conference	Estes Park, Colorado	41
11th Annual DOE Low-Level Waste Management Conference	Pittsburgh, Pennsylvania	24
Symposium: Nuclear Material Measurements--Past, Present and Future	Argonne, Illinois	51
3rd Topical Meeting on Robotics and Remote Systems	Charleston, South Carolina	3
Annual Program Managers Meeting	Pacific Grove, California	13
1989 SECP/EES/ICP State Program Managers Conference	Indianapolis, Indiana	83
Electric and Hybrid Vehicle Contractors Coordination Meeting	Idaho Falls, Idaho	15
Technical Exchange Meeting: "Assessing Indoor Radon Health Risks"	Grand Junction, Colorado	6

* DOE attendance represents Federal employees only. DOE contractor employee participation, which is not included, raised attendance levels to meet or exceed DOE review and reporting requirements set forth in the Order on Departmental Conference Activity.

SCHEDULE "C" EMPLOYEES

Mr. Bevill. Please provide a list of all Schedule "C" employees, and compare this number with FY 1988 and FY 1989.

Mr. Tarro. The total number of Schedule "C" employees on the Department of Energy rolls as of April 4, 1990 is 104 (25 of which are temporary). I would like to insert a listing of these in the record. The total number of Schedule "C" employees on board at the end of FY 1988 was 62 (0 temporary) and FY 1989 was 80 (4 temporary).

ORG CODE	EMPLOYEE NAME	CLS TITLE	PAY PLAN	GRADE OR LEVEL
0101000000	BULLOCK, JOSEPH E.	CHAUFFEUR	WG	08
	THORNTON, VICTORIA L.	STAFF ASSISTANT	GM	15
	LEYSON, ALBERTO D	STAFF ASSISTANT	GS	09
	TAEHIRO, SUZANNA C.	STAFF ASSISTANT	GS	09
	HOLLIS, KATHRYN A.	STAFF ASSISTANT	GS	11
	ALFORD, CHERYL P.	STAFF ASSISTANT	GM	14
	JONES, JACQUELINE	STAFF ASSISTANT	GS	11
	YABLONSKI, BRIAN S.	STAFF ASSISTANT	GS	05
	JONES, MICHAEL K.	SPECIAL ASSISTANT (SPEECHWRITING)	GM	15
	MATHIAS, ROBERT F.	EXECUTIVE ASSISTANT TO THE SECRETARY	GM	15
	BARBOUR, HENRY L.	STAFF ASSISTANT	GM	14
	DOWLING, CHARLES T.	STAFF ASSISTANT	GS	07
	VAUGHN, ANGELA D.	STAFF ASSISTANT	GS	09
0102000000	SABA, PETER B.	SPECIAL ASSISTANT	GM	15
	CORNICK, SUSAN A.	SPECIAL ASSISTANT	GM	15
	GENNARO, ELIZABETH BECTON	STAFF ASSISTANT	GS	12
	SANDERS, JR., WILLIAM A.	STAFF ASSISTANT	GM	15
0103000000				
	HARDELL, LISA F.	STAFF ASSISTANT	GS	07
0200000000	MICHEL, HENRY R.	STAFF ASSISTANT	GS	12
	THIEMAN, MICHAEL P.	STAFF ASSISTANT	GS	07
	PETROSKY, MARY K.	STAFF ASSISTANT	GM	14
	LAVIN, ANN W.	SPECIAL ASSISTANT	GM	15
	FLAHERTY, MEGHAN ROSE	STAFF ASSISTANT	GS	12
0301000000	ALEXANDER, MARGARET S.	STAFF ASSISTANT	GS	12
	WEST, THOMAS L.	STAFF ASSISTANT	GS	12
	WARD, CINDY C.	STAFF ASSISTANT	GM	13
	RAY, FRANK R.	SPECIAL ASSISTANT	GM	15
0302000000	TYSON, JR., ROBERT E.	STAFF ASSISTANT	GM	13
0500000000	GAY, CAROLYN SUE	STAFF ASSISTANT	GS	12
0520000000	BROWN, STUART K	LEGISLATIVE AFFAIRS SPECIALIST	GS	11
	STYLES, SCOTT B.	LEGISLATIVE AFFAIRS SPECIALIST	GS	12
	FISHER, JOHN S.	LEGISLATIVE AFFAIRS SPECIALIST	GM	14
0540000000	BURRIDGE, DEAN J.	LEGISLATIVE AFFAIRS SPECIALIST	GM	13
	SWEENEY, E. ANITA	LEGISLATIVE AFFAIRS SPECIALIST	GM	14
	DELELLO, MICHAEL S.	LEGISLATIVE AFFAIRS SPECIALIST	GS	11
0550000000	FOREMAN, ROBERT D.	INTERGOVERNMENTAL AFFAIRS SPECIALIST	GM	15
	RAY, VICKIE JO	INTERGOVERNMENTAL AFFAIRS SPECIALIST	GM	13
0552000000	ABRAHAMSON, DEBORAH L.	PUBLIC LIAISON SPECIALIST	GM	14
	BUCHAN, DOUGLAS C.	DIRECTOR, OFFICE OF CONSUMER & PUBLIC LIAISON	GM	15
0570000000	PAINTER, DENISE ANN	SENIOR PROGRAM ANALYST	GM	13
	BROWN, FREDERICK	SENIOR PROGRAM ANALYST	GM	13

ORG CODE	EMPLOYEE NAME	CLS TITLE	PAY PLAN	GRADE OR LEVEL
0700000000	CAMERON, KATHRYN	STAFF ASSISTANT	GM	15
	GONZALEZ, ROSA M.	STAFF ASSISTANT	GM	13
	CARROLL, FRANCES L.	STAFF ASSISTANT	GS	09
	SMIDA, EDWARD S.	STAFF ASSISTANT	GM	15
	BLISS, KEVIN J.	STAFF ASSISTANT	GM	15
	STICKLES, PETER W.	STAFF ASSISTANT	GM	15
0720000000	MOORE, WILLIAM CHARLES	STAFF ASSISTANT	GM	14
	HARBIN, FOSTER PIERCE III	STAFF ASSISTANT	GS	11
0900000000			GS	17
			GS	16
			GS	18
1000000000	SALAZAR, HOLLY S.	STAFF ASSISTANT	GS	11
	CUETARA, DULCE M.	DEPUTY DIRECTOR, OFC OF MINORITY ECONOMIC IMPACT	GM	15
1100100000	COES, III, RUFUS P.	STAFF ASSISTANT	GS	11
	BEARD, ROBIN J.	STAFF ASSISTANT	GS	07
1200100000	FIRIE, BRADLEY J.	STAFF ASSISTANT	GS	11
	BURNS, RUTH L	STAFF ASSISTANT	GM	14
	CORP, SUSAN ASMUS	SPECIAL ASSISTANT	GM	15
	GARY, LESLEY C.	STAFF ASSISTANT	GS	07
	ALLDAY, III, MARTIN L.	STAFF ASSISTANT	GM	14
	GARTNER, MOLLY JO	STAFF ASSISTANT	GS	09
	COLEMAN , LESLIE ANN	STAFF ASSISTANT	GS	07
1300000000	OPPENHIMER, ALEXANDER W.	STAFF ASSISTANT	GS	09
	TOWEY, MAUREEN A.	STAFF ASSISTANT	GM	13
	SMITH, SARAH G.	STAFF ASSISTANT	GS	12
1400000000	WILLIAMS, THOMAS F.	SENIOR POLICY SPECIALIST	GM	15
	JUDSON, JEFFREY M.	POLICY SPECIALIST	GM	12
	SHIFMAN, TRACY C.	STAFF ASSISTANT	GS	09
1500000000	SMITH, HELEN M.	STAFF ASSISTANT	GS	12
	KALINIAK, CATHERINE M.	PUBLIC AFFAIRS SPECIALIST	GM	14
	DIAMOND, DANIEL R.	PUBLIC AFFAIRS SPECIALIST	GS	11
	HATFIELD, JR, MARK O	STAFF ASSISTANT	GM	15
	BENTON, DAVID C.	SPEECHWRITER	GM	13
	FOX, JAMES D.	STAFF ASSISTANT	GM	13
	JONES, EVERLENER M.	STAFF ASSISTANT	GS	11
	HIGBIE, MARK S.	DEPUTY TO THE PRESS SECRETARY	GM	14
	OLSON, THOMAS C.	PUBLIC AFFAIRS SPECIALIST	GM	14
1600000000	WATKINS, CYNTHIA R.	STAFF ASSISTANT	GS	09
2100100000	SOOHER, PATRICK R.	STAFF ASSISTANT	GS	11
	HARVEY, LYNN D.	STAFF ASSISTANT	GM	12

ORG CODE	EMPLOYEE NAME	CLS TITLE	PAY PLAN	GRADE OR LEVEL
2100100000	BAILEY, JOSEPH D.	STAFF ASSISTANT	GM	14
2100200000	LORENZE, BRIEN A.	STAFF ASSISTANT	GS	11
2500000000	DRISCOLL, HELEN L.	STAFF ASSISTANT	GS	07
2501000000	MARTIN, KENT	STAFF ASSISTANT	GM	14
	LETENDRE, ROBERT P.	STAFF ASSISTANT	GS	11
	MCELROY, LESLIE J.	STAFF ASSISTANT	GS	07
	SANDERS, BEVERLY M.	STAFF ASSISTANT	GS	09
	SOLON, RITA ST. MARIE	STAFF ASSISTANT	GM	14
	REANO, PAULA JEAN	STAFF ASSISTANT	GS	11
	COX, DEBORAH	STAFF ASSISTANT	GS	09
2601000000	SMITH, DONNA L.	SPECIAL ASSISTANT	GM	13
2700000000	MCKENNA, MICHAEL A.	STAFF ASSISTANT	GS	11
	WILLIAMS, RUSSELL S.	STAFF ASSISTANT	GS	09
	KEARNEY, CHRISTOPHER B.	STAFF ASSISTANT	GS	11
	POWELL, LINDA L.	STAFF ASSISTANT	GS	11
2800000000	PETERSON, EDMUND A.	SPECIAL ASSISTANT	GM	15
2800200000	ROSSI, MICHELE N.	STAFF ASSISTANT	GM	14
2801000000	BLACKBURN, CHARLES E.	STAFF ASSISTANT	GS	11
	BOLGER, EDWARD P.	STAFF ASSISTANT	GS	11
	NELSON, DONALD W.	SPECIAL ASSISTANT	GM	15
	BAILEY, JR., PAUL C.	STAFF ASSISTANT	GM	15
	WILLIAMS, THOMAS E.	STAFF ASSISTANT	GM	14
	RODDY, RUSSELL W.	STAFF ASSISTANT	GS	09
	WILLIAMS, K. FAITH	STAFF ASSISTANT	GM	15
3101000000	GOLDSTEIN, MELISSA S.	CONFIDENTIAL ASSISTANT (SECRETARY)	GS	05
	DANOFF, WILLIAM C.	STAFF ASSISTANT	GS	07

OFFICIAL RECEPTION AND REPRESENTATION FUNDS

Mr. Bevill. Does the Department take the position that unobligated official reception and representation funds carry forward to the following years? If so, please justify.

Mr. Tarro. The Department has historically taken the position that funds provided for official reception and representation are available for that purpose only during the fiscal year for which appropriated. Funds for official reception and representation are nearly entirely obligated each fiscal year and, consequently, unobligated balances remaining are relatively insignificant. Funds that do remain at the end of the fiscal year are merged with all other generally appropriated funds for Departmental Administration, thus losing identity as to original purpose. At such time as prior year unobligated funds are reapportioned by OMB, any reception and representation balances remaining from the previous fiscal year are included. However, funds carried forward are used to support other Departmental Administration programs, not to supplement official reception and representation funds in the current fiscal year.

Mr. Bevill. What is the unobligated balances of the official reception and representation funds as of the end of FY 1989?

Mr. Tarro. Unobligated balances remaining at the end of fiscal year 1989 were $4,354.67.

OFFICE OF THE SECRETARY

ON-BOARD STAFFING

Mr. Bevill. Within the Office of the Secretary, please provide the on-board staffing by function.

Mr. Tarro. The current on-board staffing for the Office of the Secretary by function is; Immediate Office of the Secretary, 38; Office of the Deputy Secretary, 9; and Office of the Under Secretary, 8.

OFFICIAL RECEPTION AND REPRESENTATION FUNDS

Mr. Bevill. Provide a listing of the use of official reception and representation funds for FY 1989, FY 1990 and FY 1991.

Mr. Tarro. Official reception and representation expenses for FY 1989 and FY 1990 to date are shown on a list which I would like to insert in the record. Although exact expenditures have not been determined for the remainder of FY 1990 and FY 1991, it is anticipated that the utilization of funds will be similar in nature to those in FY 1989. FY 1991 request is $35,000.

(The information follows:)

FY 1989 OFFICIAL REPRESENTATION EXPENDITURES

Initial Allocation	$ 35,000.00
Receptions/meetings for final selection of the Superconducting Super Collider Site	298.54
Combined Federal Campaign training program for Senior Coordinators	46.44
Official Award Ceremony for Admiral McKee	69.85
Secretary's Official Expenses for the month of November	67.32
Reciprocal Luncheon for Visitors from United Kingdom. Meetings to discuss classification and other related issues	197.19
Official Staff Party	697.35
Official Press Party	682.16
Official CFC Senior Coordinator and DOE Senior Executive Committee Personnel Reception hosted by the Secretary	399.54
Memorabilia	75.00
Reception for recipients of Sadi Carnot, John Ericsson and Homer Lowry Science and Technology Awards	1,499.72
Secretary's Official Expenses for the month of December	21.68
Memorabilia	131.00
Small Business Awards Reception	144.09
Reciprocal luncheon for French visitors	100.00
Official Swearing-In Ceremony	150.00
Official expenses for Combined Federal Campaign Mid-Campaign Rally	45.85
DOE Participation in Working lunches/meetings during Nuclear Test Talks in Geneva, Switzerland	72.90
Secretary's Official Expenses for the month of January	61.25
Official Awards Ceremony	99.24
Memorabilia	22.50
Official Expenses for Portrait Unveiling Ceremony	498.02

Official Expenses for Proposers for Siting the Superconducting Super Collider	230.00
Official Expenses for Awards Ceremony hosted by the Secretary	500.00
Official Expenses for FERMI Award Recipients	599.44
Official Expenses incurred for working luncheons/meetings with the Intermediate Range Nuclear Force Special Verification Commission	556.23
Secretary's Official Expenses for the month of February	68.89
Memorabilia	2,431.16
DOE Participation in working meetings during Nuclear Test Talks in Geneva, Switzerland	239.50
DOE Participation in working meetings during Nuclear Test Talks in Geneva, Switzerland	33.22
Secretary's Official Expenses for the month of March	99.19
Official Swearing-In Reception	261.19
Official Swearing-In Reception	279.11
Official Expenses Incurred During Meetings to Discuss Issues of First Committee on Disarmament to the United Nations	130.50
Secretary's Official Expenses for the month of April	149.53
Secretary's Official Expenses for the month of May	36.92
Official Swearing-In Reception	183.15
Official Swearing-In Reception	962.74
Official Expenses for Press Conference	91.75
Official Expenses for Meeting with the Bar Association	52.50
DOE Participation in Official Meetings and Working Dinners to Discuss Positions of Disarmament, Outerspace and Nuclear Test Ban	273.77
Secretary's Official Expenses for the month of June	125.71
Secretary's Official Expenses for the Economic and Cooperation Ministerial Development Meeting	477.69
Official Expenses for the Eighth Joint Committee Meeting on Peaceful Uses of Atomic Energy (Soviet/Moscow Delegation)	1,700.00
Memorabilia	70.00
Official Expenses for Secretary's Summer Achievement Program	111.61
Secretary's Official Expenses for the month of July	104.16
Memorabilia	1,287.00
Memorabilia	85.86
Memorabilia	143.10
Memorabilia	253.00
Memorabilia	2,900.00
DOE Participation in Working Meetings during the Intermediate Nuclear Force Treaty's Special Verification Commission	239.24
Official Expenses for the Annual General Conference of the International Atomic Energy Agency	2,500.00
Memorabilia	837.60
Official Swearing-In Reception	110.48
Secretary's Official Expenses for the month of August	116.94
National Energy Policy Strategy Hearing Reception	100.00
Official Expenses for the Secretary's Summer Achievement Program	473.95
Secretary's Official Expenses for the month of September	350.00
Official Expenses for DOE Hearings in Tulsa, Oklahoma	136.24
Memorabilia	3,900.00

Memorabilia	5.00
Official Expenses for World Energy Congress in Montreal, Canada	1,500.00
Secretary's Official Expenses for the Month of October	450.00
Official Expenses Relating to the Nuclear Test Talks	500.00

FY 1990 OFFICIAL REPRESENTATION EXPENDITURES

Initial Allocation	$ 35,000.00
Official Swearing-In Reception	287.96
Secretary's Official Expenses for the Month of November	500.00
Memorabilia	625.00
Memorabilia	1,586.42
Official Expenses for Chief Executive Officers Luncheon	53.00
Memorabilia	233.60
Official Swearing-In Reception	150.00
Official Dinner Hosted by the Deputy Secretary During his United Kingdom Trip	690.00
Secretary's Official Expenses for the Month of December	300.00
Official Expenses for the National Energy Strategy Hearing	25.60
Official Expenses for Soviet Delegation	129.22
Secretary's Official Expenses for the Month of January	450.00
Official Expenses for the National Energy Strategy Hearing	13.50
Official Expenses for the National Energy Strategy Hearing	25.44
Official Expenses for the National Energy Strategy Hearing	46.44
Official Expenses for the National Energy Strategy Hearing	39.32
Combined Federal Campaign Reception for Eagle Recipients	200.00
Official Luncheon for Soviet Delegation	250.00
Official Luncheon for Soviet Delegation	250.00
Official Expenses for the Nuclear Test Talks	1,000.00
Secretary's Official Expenses for the Month of February	450.00
Official Expenses for Math/Science Education Action Conference	7,306.14
Official Expenses for the Nuclear Test Talks	242.36
Secretary's Official Expenses for the Month of March	400.00
Secretary's Award Ceremony Luncheon for Volunteer Recognition Program	1,393.00

TRAVEL

Mr. Bevill. Please provide the funding for travel for FY 1989, FY 1990 and FY 1991.

Mr. Tarro. The funding for the Office of the Secretary for travel in FY 1989, FY 1990 and FY 1991 was $254,000, $264,000 and $272,000 respectively.

FY 1990 FUNDING FOR THE OFFICE OF THE SECRETARY

Mr. Bevill. The FY 1990 appropriation for the Office of the Secretary was $2.1 million. Your budget request for FY 1991 shows the FY 1990 funding at more than $4.0 million. Please justify this increase and explain how this was accomplished without a reprogramming.

Mr. Tarro. When Admiral Watkins became the Secretary of Energy he was faced with numerous problems within the Department. For example, there was little or no control or effective oversight over the line management of many of the Department's projects. Contract management was unsatisfactory because there was no contractor accountability to Department of Energy management. The Defense activities were in disarray with no production reactors operating, and there were serious safety issues and environmental problems throughout the complex. To correct the situation it was necessary the increase the staffing level within the Office of the Secretary from 31 Full Time Equivalents (FTEs) to 53 FTEs. Because the FY 1990 appropriation provided for 31 FTEs, an additional $1.9 million is required to fund salaries, benefits and travel for the 22 additional FTEs. The Department is in the process of developing a strategy to fund these additional FTEs.

NUCLEAR WASTE POLICY ACT LEGISLATION

Mr. Bevill. Describe the legislative work associated with the Nuclear Waste Policy Act of 1982.

Mr. Wakefield. At present, the Department is not working on any legislative proposals relating to the Nuclear Waste Policy Act of 1982. Previously, the Department had considered the need for additional legislation in two areas. One area relates to the inability of the Department to obtain certain permits from the State of Nevada before the program can proceed with further site characterization activities. The second area concerns the linkage in current law of a monitored retrievable storage system to the schedule for the development of the repository.

It is conceivable that the Department could revisit its decision not to pursue any amendments to the Act, particularly with respect to the need for State of Nevada permits, but no deliberations to that effect are taking place in the Department at this time.

FERNALD SETTLEMENT

Mr. Bevill. Please describe the General Counsel's role in developing the $73 to $78 million settlement at the Fernald plant in Ohio.

Mr. Wakefield. With the approval of the Department of Justice, the Energy Department assumed the defense of this litigation in 1986. This activity was carried out by attorneys in the Office of General Counsel who were assigned to a trial team headed by the senior-most litigation attorney in the Office of General Counsel. The settlement itself was formulated as the result of extensive negotiations conducted by the head of the trial team, pursuant to instructions he received at each significant stage from his superiors within the Department.

ENVIRONMENTAL LITIGATION

Mr. Bevill. Describe the size and complexity of the Department's law suits dealing with environmental issues.

Mr. Wakefield. Some of the most significant and complex litigation facing the Department involves environmental issues. These issues arise both in cases where compliance with environmental laws and regulations is directly at issue and in tort cases, like Fernald, which are brought under state common law theories but involve the alleged environmental impacts of the Department's activities.

FERNALD SETTLEMENT

Mr. Bevill. Please describe the potential precedent established by the Fernald settlement with regard to future law suits.

Mr. Wakefield. The settlement of the Fernald litigation does not establish any precedent with regard to future lawsuits. Because the settlement will end the litigation, it avoids the possibility of true precedents being established on some of the novel questions presented in that case, in which trial court rulings had been adverse to the positions asserted by the Department. The legal exposure presented by each lawsuit has to be evaluated on its own facts and governing law, and it was on that basis that DOE settled both the Fernald litigation as well as a previous off-site contamination case involving diminution of value of real property adjacent to another facility.

LITIGATION

Mr. Bevill. What are the major items of litigation facing DOE in FY 1990 and FY 1991?

Mr. Wakefield. The Department is involved in approximately 130 currently active cases at Headquarters, with some 200-300 additional cases being handled by the operations offices in the field. While it is difficult to predict which of these will continue in FY 1991, I have a listing of some of the most significant pending litigation, which I would like to insert in the record. (The information follows:)

Some of the Department's most significant pending litigation during FY 1990 includes the following:

- o DuPont v. U.S. (Cl. Ct.), a case in which the former M&O contractor at Savannah River seeks reimbursement of $64 million in severance payments that it made to employees who were hired by the replacement contractor. Discovery is on-going; we anticipate summary judgment motions will be filed later this year.

- o TRW Environmental Safety Systems, Inc. v. U.S. (Fed. Cir.), a case in which the Claims Court upheld a disappointed bidder's challenge to the award of the systems engineering and development contract for the proposed nuclear waste repository. Recently SEMCO, another disappointed bidder, filed its own similar suit.

- o Energy Research Foundation v. Watkins (D.D.C.), an action alleging that DOE has failed to comply with NEPA in connection with the proposed start-up and future operations of the Savannah River Site reactors. Cross motions for summary judgment are pending.

- o NRDC v. Watkins (D.D.C.), an action alleging that NEPA requires DOE to prepare a Programmatic Environmental Impact Statement concerning modernization and cleanup initiatives for the nuclear weapons production complex. The court has indefinitely postponed the previously scheduled status conference, in the hope that the parties can come to a settlement.

- o Ohio v. DOE (6th Cir.), the Fernald environmental waste case in which we are appealing the district court's ruling that the government can be held liable for civil fines and penalties under RCRA and the Clean Water Act. Oral argument was held late last year.

- o Sierra Club v. DOE (D. Colo.), an action alleging that DOE has violated RCRA by failing to close a fluidized bed incinerator at the Rocky Flats facility. The parties are engaged in settlement talks.

- o Sierra Club v. Rockwell (D. Colo.), an action challenging DOE's determination that a plutonium recovery incinerator at Rocky Flats is not a waste treatment process requiring a RCRA permit. A March 30, 1990, hearing date on cross-motions for summary judgment has been set.

- Three Mile Island Public Health Fund v. U.S. DOE (M.D. Pa.), a case challenging DOE's partial denial of the Three Mile Island Public Health Fund's FOIA request for production of all DOE radiation health effects records. The parties have reached an agreement in principle on a settlement, and litigation has been stayed pending finalization of the agreement.

- Dollard v. Long Island Power Authority (N.Y. App. Div.), a case challenging an agreement to transfer the Shoreham Nuclear Power Plant to a state agency for $1 so that it can be decommissioned. Oral argument is set for April 16, 1990.

- U.S. v. City of Oakland (N.D. Cal.), an action in which DOE and the Navy are challenging the constitutionality of the City's Nuclear Free Zone Ordinance as applied to the federal government. A hearing on our motion for summary judgment will be held in April.

- U.S. v. Nevada (D. Nev.), a case where we are seeking an order requiring the State of Nevada to act upon permit applications needed in connection with characterization of the Yucca Mountain site. We have opposed the State's motion to stay all proceedings in the district court pending a final decision in the related Ninth Circuit litigation.

- Prescott v. U.S. (D. Nev.), a radiation injury case brought by approximately 400 former NTS employees. Trial is set for June 18, 1990.

- The Fernald Litigation (S.D. Ohio), a class action tort suit arising out of emissions of radioactive materials from DOE's Fernald plant. The Department recently paid a $16 million installment on the $73 million settlement.

- In addition, three class action lawsuits recently were filed against former M&O contractors. These suits were filed on behalf of current and former workers at Fernald, current and former workers at Rocky Flats, and residents in the vicinity of Rocky Flats, and in each the plaintiffs seek damages for alleged exposure to radioactive and hazardous materials. The Department has not assumed the defense of the contractors in these cases, but will be closely following how the cases are handled by the contractors' private counsel.

WORKLOAD MEASUREMENTS

Mr. Bevill. Describe the work load measurements used to determine the legal requirements for the General Counsel.

Mr. Wakefield. We use the Manpower Utilization Resource System (MURS) to allocate personnel resources to identified workload requirements. This management tool allows us to compare a particular type of workload (e.g., number of cases, legislative proposals, statutes to be enforced) with the number of Full Time Equivalent positions (personnel slots) in each of our divisions.

CONTRACTUAL AND TRAVEL SUPPORT

Mr. Bevill. How much contractual support and travel funds are available to the Office of the General Counsel in FY 1989, FY 1990 and FY 1991?

Mr. Wakefield. Office of General Counsel contractual support for FY 1989, FY 1990, and FY 1991 is $1,283,000; $1,324,000; and $1,182,000, respectively. Travel funds for FY 1989, FY 1990, and FY 1991 are $168,000; $164,000; and $166,000, respectively.

Mr. Bevill. Please explain their use.

Mr. Wakefield. Virtually all of the target levels for contractual services funds represent fixed costs, such as contracting for the law library function and essential contracting for domestic and international patent services. Also included are the cost of legal transcript services, publication of legal documents, and funding for the General Counsel's training activities. Travel funds enable our attorneys to appear in depositions, hearings, and trials throughout the United States.

BUDGET REQUEST

Mr. Bevill. Please provide the Inspector General's budget request to the Department and to the OMB for FY 1991.

Mr. Layton. Our request to the Department for FY 1991 was for $28,848,000. The request to OMB was for $28,421,000.

REPROGRAMMING OF FUNDS

Mr. Bevill. Please provide a listing of any reprogrammings of funds appropriated to the Inspector General in FY 1988, FY 1989 or FY 1990.

Mr. Layton. There were no reprogrammings of funds in FY 1988. In FY 1989, a total of $678,000 was reprogrammed. $298,000 was reprogrammed from capital equipment to operating expenses (contractual support services) for computer related acquisitions; $50,000 from salaries to benefits; $150,000 from other compensation to benefits; $100,000 from contractual services to benefits; and $80,000 from contractual services to travel. There have been no reprogrammings to date in FY 1990.

RESOURCES DEVOTED TO FINANCIAL AUDITS

Mr. Bevill. Please provide a breakout of the resources of the Inspector General devoted to financial audits in FY 1989, FY 1990, and FY 1991.

Mr. Layton. Over the last several years, we have consistently devoted about 75% of our available audit resources to financial and financial related audits, and we expect this trend to continue into FY 1991. These audits primarily consist of contract audits (preaward, cost incurred, close-out, defective pricing, etc.), but also include financial statement audits at DOE's management and operating contractors, and stand alone financial audit work such as internal cost controls and audits of imprest funds at DOE facilities. The remaining audit resources are devoted to performance audits of programs and activities. Many of these audits, either directly or indirectly, deal with financial, compliance, internal control and budget matters.

JUSTIFICATION FOR INCREASE IN IG STAFFING

Mr. Bevill. Please justify the requirements to increase the IG staffing from 189 in FY 1989 to 240 in FY 1990 and 256 in FY 1991.

Mr. Layton. Additional audit staff in FY 1989 and 1990 allowed us to provide coverage of previously unaudited areas and to provide additional coverage on areas of current DOE emphasis. These areas of emphasis include: environment, safety and health; safeguards and security; and Defense programs. Additional investigative resources in FY 1990 will enable us to focus more resources on the more complex criminal cases, giving emphasis to significant contract/procurement fraud cases; high risk environmental, safety and health cases; and cases involving the integrity of Departmental and contractor officials. An additional 16 FTEs are requested in FY 1991 for our Office of Inspections and Analysis. Inspections and Analysis currently has two divisions, the Headquarters Division and the Field and Special Operations Division. Most of these new positions will be assigned to a newly created third division, the Program Review Division. This division will perform general management reviews of Operations Offices, Area Offices, Programs, Power Marketing Administrations, and Headquarters organizations. These inspections will address a wide range of subject areas including: environment, safety and health; defense programs; research and development; oversight of contractors; industrial relations; personnel practices; and procurement practices. These additional positions will also allow for more timely

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inquiries into allegations of a non-criminal nature. These allegations are often received from the public, Congress, Departmental management and concerned employees who have concerns about possible ineffective or wasteful practices within the Department.

INCREASE IN INSPECTIONS AND ANALYSIS

Mr. Bevill. Justify the 84 percent increase in the Office of Inspections and Analysis in FY 1991.

Mr. Layton. The 84 percent increase equates to 16 additional FTEs we are requesting in FY 1991 for the Office of Inspections and Analysis. This office has a number of important functions. It performs special inquiries into management issues and allegations of a non-criminal nature often based on congressional or Departmental requests. Also, this office performs reviews to identify deficiencies which, when corrected, will enhance the efficiency and effectiveness of the DOE programs, thereby ensuring that Federal funds are being spent in a productive manner and for the purposes appropriated.

SUCCESSES OF PROGRAMS IN THE OFFICE OF MINORITY ECONOMIC IMPACT

Mr. Bevill. Please describe some of the successes of your program in FY 1989 and FY 1990.

Ms. Wray. The program has made some significant accomplishments during this period, especially in FY 1990. Some of the more important ones are listed below.

- In a joint effort with the National Aeronautics and Space Administration, a pool of minority professionals is being trained through an enhanced program of science and technology training and research.
- Two consortiums have been formed between a minority educational institutions and two other educational institutions to develop a pool of technical scientists for specific requirements in the energy industry. One of these is with the University of Oklahoma for mechanical engineering and the other is with the University of Nevada at Las Vegas for electrical engineering.
- Unique analytical tools developed by MI's Research Program are being utilized in Departmental efforts for the National Energy Strategy and the National Energy Modeling System.
- Micro-computer versions of the Research analytical tools are being "field tested" to increase the overall assessment capabilities of DOE and energy industry regulators, planners, and educational institutions.

- o New alliances have been formed among minority educational institutions and industry, government, and research laboratories (e.g. environmental restoration and waste management).
- o A Minority Energy Information Bulletin Board System has been developed and implemented to provide information on MI's programs and other Departmental programs that impact minority population groups.
- o A prototype educational and business development training program has been developed to focus on energy-related business opportunities and establish industrial linkages.
- o Strategies have been developed to structure a more efficient Bank Deposit Financial Assistance Program.
- o The Minority Honors Training and Industrial Assistance Program, targeted at underrepresented minorites at two-year post secondary institutions, served approximately 350 students for each of the two fiscal years.

MINORITY EDUCATIONAL INSTITUTION ASSISTANCE

Mr. Bevill. Please explain the reduction in the Minority Educational Institution Assistance Program.

Ms. Wray. The 71 percent reduction does not reflect a decision by my Office to reduce the level of support for minority educational institutions. It represents the changed FY 1990 estimate that provides a substantial one-time increase in funding that will be costed over FY 1990 and 1991. With these factors taken into account, the FY 1991 request

reflects a 21 percent reduction in new authority from the $1,681,000 1991 base. However, the total support in FY 1991 including a portion of the reprogrammed funds from FY 1990 ($1,200,000) will exceed the FY 1991 base.

MINORITY ENERGY INFORMATION CLEARINGHOUSE

Mr. Bevill. Please explain the reduction in the Minority Energy Information Clearinghouse activities. What have been the FY 1989 and FY 1990 successes of this program?

Ms. Wray. The reduction in the budget for the Minority Energy Information Clearinghouse activities does not necessarily reflect a reduction in the level of activities for the program. The reduction reflects a continuing assessment of the needs of some of the projects in the program, based on the projected level of involvement of private industry organizations with the projects and the capabilities of the Clearinghouse to link with other databases at the national laboratories and other Federal agencies.

During the last two fiscal years, the information dissemination has been enhanced by the addition of the Minority Energy Information Clearinghouse Bulletin Board System (MIBBS). This is a 24-hour on-line system that provides information on MI's programs and other DOE programs that impact the minority population.

A new database for the Minority Honors and Industrial Assistance Program has been developed and is currently being tested. This new

system will assist the Office in monitoring and evaluating the success rate of students supported under this program.

The Minority Education Institutional Tracking System (MEITS), which tracks procurement and financial awards to minority educational institutions, is now operational.

MAJOR ENERGY POLICY ISSUES

Mr. Bevill. Please describe some major energy policy issues you are developing and describe how these are implemented by the program offices.

Ms. Stuntz. Major energy policy issues that we are currently addressing include:

OIL ISSUES

o what are the financial and regulatory burdens on the oil industry;

o what are the weaknesses within the domestic petroleum industry;

o what is the impact on domestic petroleum supplies and production of environmental regulation;

o what is the shape of current and future world oil markets;

what are the factors affecting domestic oil production;

NATURAL GAS ISSUES

o what are the barriers to the expansion of natural gas pipelines into new domestic markets;

*o what is the deliverability of existing natural gas reserves and what factors affect that;

o what policies will promote the reliability and adequacy of natural gas supplies, particularly in light of new projected demand;

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*Jointly undertaken by PE and one or more program offices.

ENERGY EFFICIENCY ISSUES

*o continuing comprehensive assessment of costs and benefits of flexible and alternative fuel use in the transportation sector;

*o managing the implementation of the Alternative Motor Fuels Act of 1988;

o managing the Interagency Commission on Alternative Fuels and the U.S. Council on Alternative Fuels;

o analyzing energy use in each of the Nation's energy end-use sectors, and related efficiency achievements and conservation trends;

o analyzing technical and economic potential for increased fuel efficiency in the transportation sector;

ELECTRICITY ISSUES

*o analyzing Title III of S. 324, the National Energy Policy Act of 1989, that would amend the Public Utility Regulatory Policies Act of 1978 to encourage energy conservation and least-cost planning activities by electric and gas utilities;

*o continuing analysis of electricity industry issues, such as Public Utility Holding Company Act reform, growth of independent power producers, and competitive bidding;

*o analyzing the effects of the proposed acid rain legislation on electric utilities and on the natural gas industry;

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*Jointly undertaken by PE and one or more program offices.

*o analyzing uncertainties associated with least-cost utility planning -- assessing the role of least-cost utility planning in meeting projected electricity requirements;

TECHNOLOGY TRANSFER

*o coordinating the development of Departmental policy for technology transfer, including implementation of the National Competitiveness Technology Transfer Act of 1989;

*o conducting technology transfer analysis to enhance domestic industrial capabilities as an adjunct to DOE's energy, science, and defense missions;

ENVIRONMENTAL ANALYSIS ISSUES

o analyzing global climate change, air quality, water and waste issues as they relate to the domestic energy industry; and

o analysis of and participation in international activities related to global climate change and associated environmental issues.

The Policy Office works collaboratively with DOE's program offices, as can be seen by the number of reports and studies that Policy is doing jointly with those offices. The results of this work are implemented, as appropriate, by those offices. In addition, the Policy Office has responsibility to review much of the testimony and correspondence generated by the program offices. This helps to ensure that DOE speaks in a

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*Jointly undertaken by PE and one or more program offices.

coordinated manner. Finally, the Secretary has directed the Policy Office to: (1) develop a new planning function to integrate DOE budget and policy across the entire Department; (2) develop, coordinate and implement the National Energy Strategy; and (3) provide the support for a newly established Department of Energy Executive Committee. This Committee will improve executive oversight and coordination of long-term, cross-cutting issues. The Policy Office will be responsible for coordinating all Committee activities on the Deputy Secretary's behalf.

POLICY, PLANNING AND ANALYSIS STUDIES

Mr. Bevill. Please provide a listing of the studies conducted by your office in FY 1989, FY 1990 and planned for FY 1991. Please state the cost of each and how the studies resulted in a change in DOE policy.

Ms. Stuntz. The studies for FY 1989 and FY 1990 are shown in the following listing, along with the FY 1991 study plan. Note, that the studies planned and listed for FY 1990 and FY 1991 may be modified or deleted if changing energy conditions dictate the need for higher priority analyses. The FY 1990 and FY 1991 listings include the source studies needed for publishing the National Energy Strategy that is due this year.

STUDIES CONDUCTED IN FY 1989
(IN THOUSANDS OF DOLLARS)

Oil Prices and Conservation Trends	15.0
Oil Trade Model Enhancement	70.0
Analysis of OPEC Pricing and Production Trends	10.0
Tax and Fiscal Treatment of Oil and Gas Exploration and Production	60.0
Analysis of the Electricity Industry Structure	95.0
Analysis of Natural Gas Production Controls	35.0
Transportation Fuels and Efficiency	170.0
Transportation Fuels and Efficiency (Fuel Economy Potential)	20.0

Effect of Energy Use on International Competitiveness	55.0
Flexible Fuels Infrastructure Integration (Fuel Choice Analysis)	30.0
Technical Analysis of the Costs and Benefits of Developing a Flexible-Fuel Transportation System (Alternative Fuels Trade Analysis)	40.0
Electricity Conservation Potential	15.0
Conservation Policy Support	198.0
Analysis of the Amendment to the Public Utility Holding Company Act	20.0
Development of an Updated Oil and Gas Supply Sector for the Fossil2 model	87.0
Fossil2 Energy Model Structural Modifications	30.0
Analysis of Soviet Resources within the World Natural Resource Base	6.0
Analysis of the Impact of Oil Price Changes and Energy Imports on the Competitiveness of U.S. Export Industries	9.5
Analysis of Determinants of Oil Price Stability and their Consequences	9.8
Provide Analysis of the Adequacy of Environmental Information for Oil and Gas Leasing Decisions	75.0
Provide Analytical Support in the Development of a Series of Papers in the Area of Conservation	19.0
The Effects of Least-Cost Utility Planning of Transmission and Distribution Policy	15.0

Provide Technical Assistance in the Formulation/ Implementation of National Energy Policy to Support the National Energy Strategy	100.0
Evaluate Transportation Energy Policy Issues	75.0
Analysis of the Infrastructure on Alternative Fuels	10.5
Analysis of Electricity Supply Options	55.0
Analysis of Natural Gas Supply Options	60.0
Provide Analytical Support for Baseline Analysis for the Development of the National Energy Strategy	100.0
Transportation Fuels and Efficiency (Transportation Policy Options)	25.0

ON-GOING AND PLANNED STUDIES FOR FY 1990
(IN THOUSANDS OF DOLLARS)

Provide Analytical Support in the Development and Implementation of the National Energy Strategy	170.0
Provide Analytical Support for Technology Transfer Issues	75.0
Recommend Methodology for Assessing National Energy Policy Options, and Recommend Methodology for Integrating National Energy Strategy	15.0
Support the Completion of the Interlaboratory Renewable Energy White Paper, Review the Economic Assumptions/Projections for the NES, and Conduct Analysis to Support the NES	25.0
Provide Modeling and Analytical Support for the Development of the National Energy Strategy	128.0

Provide Technical Assistance in the Formulation/ Implementation of National Energy Policy to Support the National Energy Strategy	405.0
Flexible Fuel Infrastructure Integration	35.0
Profile of the U.S. Crude Oil Production Industry	10.0
Profile of U.S. Stripper Well Oil Production	10.0
Profile of U.S. Oil Service Industry	10.0
Analysis of the Fossil2 Oil and Natural Gas Models to Support the National Energy Strategy	103.0
Provide Technical Analysis, Assessments and Evaluations for Transportation Energy Policy Issues in the Areas of Alternative Fuels	35.0
Analysis of Strategic Petroleum Reserve	9.6
Develop the National Energy Modeling System to Support the Development of the National Energy Strategy	676.0

ON-GOING AND PLANNED STUDIES FOR FY 1991
(IN THOUSANDS OF DOLLARS)

Oil and Natural Gas Tax Analysis	125.0
Analytical Support for Technology Transfer Issues	175.0
Analysis of the Impact on Fossil Fuels from Changes to the Clean Air Act	225.0
Energy Efficiency - Transportation Sector	125.0
Energy Efficiency - Building Sector	125.0
Energy Efficiency - Electric Utility Sector	125.0
Energy Efficiency - Industrial Sector	125.0

Energy Efficiency - Cross-Sectorial Analysis	125.0
Analysis of Alternative Fuel Use in Transportation	150.0
Analytic Support for Legislatively Required Alternative Fuel Program	110.0
Analysis of World Oil Markets and U.S. Refining Capacity	225.0
Analysis of U.S. Petroleum Product Markets	175.0
Analysis of U.S. Petroleum Industry Infrastructure	100.0
Analysis of Natural Gas Supply Deliverability and Potential Transportation Constraints	140.0
Analytical Support for the Development of the National Energy Strategy	500.0
Development and Improvements to Energy Models	300.0
Analysis in Support of the Implementation of the National Energy Strategy	500.0

Studies conducted by this Office are essentially analytical tools used to obtain general or specific knowledge on an energy issue or a crosscut of issues. The studies define energy issues and provide the data necessary to make informed policy choices. They are instrumental to the examination of alternatives and the formulation of policy positions. Since most policy changes are evolutionary, these studies provide the foundation for the incremental development of new policies.

For example, a recommendation of the Energy Security Report of 1987 was that increased attention be paid to developing alternative transportation fuels. The Policy Office, consequently, has undertaken a number of

alternative fuels studies to better define alternative fuel options, and the costs and benefits of those options. This work on alternative fuels contributed to the formulation of the clean fuels program contained in the President's proposed Clean Air Act amendments. Similarly, the Policy Office's analyses of electricity industry regulation and structure contributed directly to the Department's recent intervention in a FERC proceeding. In that case (Public Service Company of Indiana, Docket No. ER89-672-000), DOE supported a utility's request to charge market based prices for electricity in exchange for making its transmission facilities available for use by others.

The analysis performed by and for the Policy Office also has supported the Department's participation in interagency efforts such as the President's Outer Continental Shelf Task Force, a Commerce Department led effort evaluating the export of limited volumes of California heavy crude oil, Strategic Petroleum Reserve size and financing options studies, and the development of oil and gas tax incentives, including ongoing efforts to effectively define and implement existing tax incentives. In addition, the Policy Office is playing a leading role in implementing the National Competitiveness Technology Transfer Act of 1989 and expects to be increasingly active in the area of technology transfer policy for the Department.

These are just some of the areas where Policy Office studies are contributing to the formation of DOE policy.

COORDINATION BETWEEN POLICY OFFICE AND PROGRAM OFFICE

Mr. Bevill. Please describe the coordination between your office and the program offices conducting policy analysis.

Ms. Stuntz. The Office of Policy, Planning and Analysis (PE) reviews national energy policies, provides oversight of policy development and implementation, and performs analyses to ensure that policy options are evaluated based on their consistency with sound economic principles. In this role, PE identifies major policy issues for study. During the early stages of issues development, PE consults with other program offices to solicit ideas on the appropriate analytical framework for a study or analysis, as well as ensuring that no duplicative analysis is underway. Where mutual interest warrants, studies or analyses are funded jointly by PE and other program offices. Analyses and studies originated by PE or a program office are circulated for review and comment during preliminary and final draft stages. This cooperative analysis and evaluation process assures the development of policy options based on sound economic principles and a consensus within the Department. In addition, PE is responsible for the integration of energy policy options proposed within the Department and for the interagency coordination of analyses conducted by the Department.

NATIONAL ENERGY POLICY

Mr. Bevill. Please describe your program to analyze DOE programs to ensure their consistency with national energy policy.

Ms. Stuntz. The Policy Office was assigned the Department's responsibility for coordinating the development of the National Energy Strategy (NES). To implement this strategy within the DOE, the Policy Office was reorganized in March 1990 and assigned new responsibilities that include establishing a Department-wide planning and program analysis capability to bring plans and programs into line with near, mid and long-term recommendations of the NES. We plan to have the emerging strategy reflected in the DOE budget submission for fiscal year 1992. The NES, as finally approved by the President, will be integrated with the budget for fiscal year 1993. Linking policy and budget in this way should insure that DOE programs are consistent with national energy policy.

ENERGY PROBLEMS IDENTIFIED IN THE NATIONAL ENERGY POLICY PLAN

Mr. Bevill. Please describe how the Department's programs are specific to the energy problems identified in the National Energy Policy Plan.

Ms. Stuntz. The "interim" National Energy Strategy (NES) report was issued on April 2, 1990. The report marks the completion of the first phase -- information gathering -- of the NES development proces. The report provides a series of goals that were identified by the public to improve our ability to meet energy needs in an environmentally acceptable manner. The public input to this report identified 49 goals, 756 options for attaining these goals, and 449 obstacles to achieving the goals. While it is by no means a complete list, it does identify many of the public concerns and divergent viewpoints regarding our future energy problems.

As an example, publicly identified goals in the Oil section of the report are:

- Enhance the Nation's energy security by minimizing dependence on less secure supplies of oil and reducing U.S. vulnerability to the adverse impacts of supply disruptions.

- Ensure a proper balance among the Nation's need for energy security, its economic competitiveness, and the environmental impacts of exploration, production, transportation and refining.

Some obstacles identified for attaining these goals relate directly to Departmental programs:

- DOE could devote more of its budget to research and development on petroleum exploration, including resource characterization.

- DOE could place higher priority on near-term geoscientific research and lower risk energy supplies.

This relationship between publicly identified goals, obstacles and Department programs appears frequently throughout the document. Conversely, options listed for overcoming obstacles often are directed at DOE programs:

- The Department of Energy could continue its policy for early and maximum release of SPR oil in emergency situation.

The findings of the NES will be integrated into the Department's budget. In FY 1991, we began this process, drawing upon the public input already received to develop budget priorities. We anticipate that the FY 1993 DOE budget will fund programs and identify priorities that reflect fully the energy problems and solutions identified in the NES, both through the public comment period and through internal deliberations.

IMPACT OF THE PROPOSED CLEAN AIR ACT

Mr. Bevill. Please provide your analysis of the impact of the proposed Clean Air Act on energy needs of the Nation.

Ms. Stuntz. The Clean Air Act Amendments being considered in the House and passed by the Senate pose new challenges to the energy industry. However, if the Clean Air Act amendments ultimately passed by Congress meet the tests of balance, cost and feasibility set forth by the President, we can enjoy substantially cleaner air while maintaining adequate supplies of reasonably priced energy to meet the needs of the Nation.

Based upon analyses performed for the Environmental Protection Agency by ICF, the Department has estimated how H.R. 3030 would affect the coal, gas, oil, and electric power industries. These estimates are based upon the provisions of the Bill as proposed by the President and initially introduced in the Congress. Changes to the Bill's provisions during the legislative process could result in changes to these projections.

Concerning the coal industry, we believe that the total tonnage of coal used would not be dramatically reduced by the legislation, but that distribution of coal production would be affected. High sulfur coal production from the Midwest and Northern Appalachia would be displaced by low sulfur coal production from Central and Southern Appalachia. Typical projections for the year 2000 are for regional shifts of about 100-120 million tons of coal production or about 10 percent of projected national

production. Local impacts are somewhat greater: Northern Appalachia would lose about 25 percent of its projected mining activity; the Midwest would lose about 45 percent. Again, both of these numbers are from projected levels, not current levels.

DOE estimates that H.R. 3030 will increase the cost of producing electricity from coal by approximately 5-8 percent. The Department of Energy's Energy Information Administration (EIA) has estimated that a 10 percent increase in coal costs would increase natural gas use about 10 percent above projected consumption in the year 2000 and would reduce coal use by about 4 percent (roughly 30-40 million tons per year) from projected year 2000 usage. The amounts of oil-fired and nuclear generated electricity and hydroelectricity were largely unaffected by the increase in coal use costs.

With respect to gas markets, H.R. 3030 is likely to increase the demand for low emissions generating technologies such as gas-fired combined cycle generation. It will also increase the use of gas to cofire coal boilers. Consequently, some increase in natural gas consumption by the electric generation sector would be expected under H.R. 3030 beyond the significant increase in gas use by utilities that we already are projecting.

The EIA study cited above found that if the cost of generating electricity from coal were to increase by 10 percent, year 2000 natural gas consumption in the utility sector would increase by approximately 12

percent. Since DOE has estimated that H.R. 3030 would cause the cost of burning coal to increase by approximately 8 percent, natural gas consumption should increase by less than 10 percent over projected levels.

Concerning the impact of H.R. 3030 upon the oil industry, the amount of oil used for electric generation is relatively small (less than 10 percent), although it is growing rapidly. The ICF analysis of H.R. 3030 indicates that by the year 2010, natural gas consumption for electric generation could increase by one quad over projected levels. This increased use of natural gas for electricity generation would displace approximately 470,000 barrels of residual oil per day. It is not likely that this relatively small reduction in demand for oil, spread over a 20-year period, would have any measurable effect upon the price of oil.

The petroleum industry will also be affected by alternative fuels and air toxics provisions. The alternative fuels provisions will require significant capital investments in new refining, transportation, and storage equipment. The impact upon the refining industry of the air toxics provisions also is likely to be large; however, the range of the costs is quite uncertain. Data from the American Petroleum Institute (API) suggest that the entire petroleum industry faces costs from $3.2 billion to $12.8 billion to meet new air toxic regulation requirements. Costs ranging from $0.35 billion to $2.34 billion may be imposed on the refining industry alone. DOE is analyzing these provisions and their effect on the energy industry.

With regard to electricity markets, based upon EPA estimates of 1.2 percent to 1.8 percent average electricity rate increases and EIA estimates of long-run price elasticities (i.e., the percent change in consumption in response to a one percent change in price), we estimate that the Administration's proposed acid rain legislation would reduce electricity consumption by approximately 0.46 percent to 0.74 percent, or about 16.0 billion to 25.7 billion KWH in 2001, the first year of Phase II as compared to projected levels under current law.

OFFICE OF PUBLIC AFFAIRS

Mr. Bevill. Please provide a general description of the objectives of your programs and how they impact on the Department's programs.

Ms. Jameson. The Office of Public Affairs is responsible for managing and ensuring the coordination of departmental relations with the news media and the general public. The office is responsible for serving as an intermediary with the news media and general public. The office is responsible for serving as an intermediary with the news media and general public to significantly increase public awareness of energy programs and to ensure the public of the Department's major initiatives to keep them informed at all times.

Our strategy is to inform the American people of DOE's efforts to ensure that America has abundant, affordable and environmentally safe energy resources, inform the American people about energy issues, and make clear the Department's commitment to health, safety and the environment.

CONGRESSIONAL AND INTERGOVERNMENTAL AFFAIRS

Mr. Bevill. Please provide a general description of the objectives of your programs and how they impact on the Department's programs.

Mrs. Brown. My office is responsible for providing overall coordination and outreach for the Department's programs by serving as the principal point of contact to work with the Congress, Federal, State and local policymakers as well as public interest groups and industry. Basically, we provide assistance to the program offices in working with Members of Congress and outside groups to ensure that consistent policy information is provided and to expedite the flow of information to Members of Congress and their staffs and the general public.

Mr. Bevill. Please describe the rationale and expected impact of eliminating the funding for Indian Affairs.

Mrs. Brown. We have not requested funding for the Indian Affairs program since 1988 because we felt the primary goal of our efforts, which was to assist the Indian Tribes in reaching self-sufficiency in terms of their capacity to manage their energy resources, had been achieved. My understanding is that these Indian Tribes are now capable of financing and managing development of their energy resources. Although my office no longer contracts directly with the Indian Tribes, we do maintain active liaison with Tribal governments and their representative organizations and provide assistance to them in establishing linkages with outher programs in the Department. Indian Tribes are currently participating in our Clean Coal

Technology Program; the National Congress of American Indians receives a substantial grant under the Office of Civilian Radioactive Waste Management; Tribal governments have been intimately involved in the development of our Five-Year Cleanup Plan for DOE facilities and will be receiving assistance from DOE for activities involving the transportation of transuranic waste across Indian lands. In addition, the Office of Minority Economic Impact works closely with Tribal businesses.

Mr. Bevill. What is the FY 1989, FY 1990 and FY 1991 funding of the Division of Consumer Affairs?

Mrs. Brown. The funding for the Office of Consumer and Public Liaison in FY 1989 was $67,000; in FY 1990 $64,000; and in FY 1991 $45,000.

Mr. Bevill. Describe the Department's program to assist native Americans to develop their energy resources.

Mrs. Brown. The Department of the Interior has primary responsibility for working with native Americans and coordinating with other federal agencies to assist Indian Tribes in the development of self-sustaining tribal governments under the trust relationship of the Federal Government.

The Department of Health and Human Services, Administration for Native Americans, provides assistance to Indian Tribes on matters involving economic development and capacity building.

The Department of Energy participated for 12 years in an interagency effort to fund the Council of Energy Resources Tribes (CERT) designed to assist the Indian Tribes in the development and management of their energy

resources. The contract for this program expired on March 31, 1989. It is my understanding that this effort continues to be managed by the Administration for Native Americans.

Mr. Bevill. Describe the efforts of your Office of Competition.

Mrs. Brown. The Office of Competition conducts background studies that assess the competitive efforts on the energy industry of proposed legislation. Currently we are doing research and analyses on the Clean Air Act. The Office is also working on analyses of the competitive implications of oil pipeline deregulation, electric power competition, and gasoline marketing.

Mr. Bevill. Describe the elimination of contractual support for the Office of Competition.

Mrs. Brown. The Office of Competition has not had a need to expend previously appropriated contractual support for several years. We are able to carryover sufficient funds to the 1991 fiscal year to accommodate any unanticipated contractual needs for that period.

SUPPORT TO INTERNATIONAL COLLABORATION

Mr. Bevill. Describe the difference between your role and that of the Program Officials with regard to these international collaboration.

Mr. Easton. Program Officials are primarily responsible for determining how proposed international collaboration would fit into their overall program objectives and priorities, deciding to proceed with international projects, developing the detailed technical scope and actually supporting the technical activities. My office provides the policy framework for such collaboration and makes the necessary formal arrangement through appropriate international agreements for its accomplishment.

ROLE IN INTERNATIONAL COLLABORATION

Mr. Bevill. A number of program budgets for activities such as Magnetic Fusion, General Science and Nuclear Energy indicate the international aspects to their programs. What is your role in these programs?

Mr. Easton. My office represents the Secretary and the Department as a whole with respect to international R&D by emphasizing policy development, coordination with the State Department on all foreign policy considerations, coordination with other Departments as appropriate, and assuring the international activities conform to Department of Energy and Administration policies. We deal with the cross cutting issues such as technology transfer, R&D balances across technologies with specific countries, sensitive country activities, programs with developing countries, foreign travel, and visits and assignment to DOE Laboratories. We are also responsible for the development and negotiation of the formal international agreements.

FOREIGN ENERGY DEVELOPMENT PROGRAMS

Mr. Bevill. Provide a brief synopsis of the major energy development programs outside the United States. What are the comparable spending levels with DOE's programs?

Mr. Easton. Comparative data for energy R&D funding in 1988 is the lastest that is available for countries in the International Energy Agency (excluding France). These data confirm the continuation of several important trends that began as early as 1981 and were noted last year. These trends are continuing reductions in the total level of public spending (about 7% in 1988 as measured in U.S. dollars) but at a slower rate than the preceding two years, and a traditional emphasis upon long-term, high risk technologies, e.g., conventional and advanced nuclear, and fusion.

Excluding the United States, the seven IEA countries with 1988 R&D Budgets greater than $100M allocated over 60% of total funding to conventional and advanced nuclear and fusion, a level slightly lower than the preceding year but higher than about the 50% level in the U.S. For the same countries, R&D in the field of fossil energy commanded approximately 16% of the total (oil/gas 5%, coal 11%) while renewables and conservation accounted for about 8% and 6% respectively. A variety of fields (advanced electrical storage systems, high voltage transmission, energy/environmental programs, information management, etc.) accounted for the remainder. The fossil, renewable and conservation percentages are in rough agreement with program funding percentages in the United States.

With some exceptions, these trends continue to be complemented by an increasing reliance upon the private sector in order to demonstrate technologies with commercial or near-commercial potential. This is particularly the case in the fields of renewable energy and conservation, in which major IEA countries have followed the U.S. lead to gradually reduce fiscal subsidies supporting such technologies. In addition, there is increasing international emphasis upon the clean use of coal and the importance of greater industry/government collaboration for the development of related, advanced energy supply systems based on coal as a fuel or feedstock.

INTERNATIONAL R&D AGREEMENTS

Mr. Bevill. Describe the international R&D policy of the Department as developed by your organization?

Mr. Easton. Our policy is to promote an enhanced international R&D collaboration effort that will: maximize opportunities for early consultations with potential partners; expand opportunities to increase scientific and technological knowledge related to energy; maximize the productivity and value of science and energy R&D investment; improve long-term energy security of the U.S. and our collaborating partners; and improve overall U.S. international relations.

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INTERNATIONAL POLICY STUDIES

Mr. Bevill. Provide a listing and funding of all International Policy studies funded in FY 1989, FY 1990 and FY 1991.

Mr. Easton. A listing of studies funded in FY 1989 and FY 1990 as well as those studies proposed for FY 1991 is provided for the record.

(The information follows:)

FISCAL YEAR 1989 CONTRACTS
(Dollars in Thousands)

Technical Support to Office of International Research & Development Policy	$ 50
Global Warming Survey	25
IPCC Global Climate Change Meeting	25
Ad Hoc ADP Support for IE-10	60
Nuclear Energy Analysis Program (NEAP)	75
Support for IAEA Recruiting System	70
Internal Control Reviews of Interagency Reimbursable Agreements	56
Support of International Energy Conference (International Research Center)	30
Higher Education Institutions capabilities for International Affairs	75
Western Hemisphere Energy Study	180
U.S. Energy Policy for the 1990's (Atlantic Council of the U.S.)	99
Security of electricity supply in Western Europe	85
Total	$830

FISCAL YEAR 1990 CONTRACTS
(Dollars in Thousands)

Technical support services for international energy R&D policy development and implementation	$ 60
Systems development for foreign travel and visits and assignments management information	110
Technical support services for IAEA activities	130
Recruitment system for IAEA personnel placement	55
Preparation for NPT Review Conference	25
Analytical services in support of bilateral nuclear nonproliferation policy development	50
Development of technical exchange briefings for semi-annual bilateral energy discussions	40
Analyze energy, and economic and trade opportunities in key world regions	350
Transcription services for IEA meeting with industry participants	84
Analysis of European electricity grid and trade	70
Canadians Energy Research Conference	25
Total	$999

FISCAL YEAR 1991 CONTRACTS
(Dollars in Thousands)

Technical support services for international energy R&D policy development and implementation	$ 80
Systems development for foreign travel and visits and assignments management information	20
Technical support services for IAEA activities	140
Enhanced tracking system for nuclear cooperation agreements, administrative arrangements and subsequent arrangements	75
Recruitment system for IAEA personnel placement	55
Analytical services in support of bilateral nuclear nonproliferation policy development	130
Analyze and promote energy, energy technology, and energy service industry trade	330
Development of technical exchange briefings for semi-annual bilateral energy discussions	40
Transcription services for IEA meetings with industry participants	114
Analysis of European electricity grid and trade	75
Subtotal	$1,059
Reduced Enrichment for Research and Test Reactors	$300
Subtotal	300
Grand Total FY 1991	$1,359

FOREIGN TRAVEL FOR INTERNATIONAL AFFAIRS

Mr. Bevill. Please provide the amount of funding for foreign travel used by your office for FY 1989, 1990 and FY 1991.

Mr. Easton. Foreign travel for the office of the Assistant Secretary and the Office of International Affairs is $387,000 for FY 1989, $401,000 for FY 1990 and $380,000 for FY 1991.

FOREIGN TRAVEL CONTROL

Mr. Bevill. Please describe the Department's control procedures for foreign travel and the impact and role your office has on these procedures.

Mr. Easton. All foreign travel requires senior program or field official approval. IE reviews all travel requests to ensure conformity with Departmental policy and international objectives (including reciprocity in our energy relations with other countries), and is responsible for approving all foreign travel by DOE employees. Contractor travel to sensitive countries or dealing with sensitive energy topics requires IE approval, along with that of the Offices of Safeguards and Security and International Security Affairs, both within the Office of Defense Programs. The DOE foreign travel board, consisting of the Director of Administration and me, reviews sensitive travel issues identified by IE, and establishes broad policies and attendance levels for major international conferences.

Significant changes in our policies and management of foreign travel were instituted late in 1986. A new DOE foreign travel order was issued in November of that year. The order provides for streamlined approval authority, while enhancing accountability for senior management. IE has continued to improve the management information systems. These systems give greater opportunity to review proposed foreign travel to ensure consistency with foreign policy and with DOE programmatic activities as well as give guidance to travel approval authorities when the number of proposed travellers appears excessive.

As directed by the new Order, IE has developed a DOE-wide automated foreign travel management system. It is currently in the testing stage, and is expected to be in full operation before the end of the fiscal year. This new system will greatly improve the efficiency of processing foreign travel requests by eliminating unnecessary paperwork and expediting the approval process.

INCREASE IN INTERNATIONAL ENERGY POLICIES

Mr. Bevill. Please describe the increase in International Energy policies.

Mr. Easton. Our funding request for our policy and analytical studies increases by $60,000, from $999,000 to $1,059,000, to cover inflationary cost increases. A new item for International Affairs budget request is $300,000 for the Reduced Enrichment for Research and Test Reactors. This program was funded for $1,200,000 in the Office of Nuclear Energy budget in FY 1990. This program will focus on conversion of foreign research and test reactors from highly enriched uranium fuel to our newly developed low enriched uranium fuel. These activities will include technology transfer, training, and technical assistance to foreign reactor operators.

IAEA SUPPORT

Mr. Bevill. How much FY 1989, FY 1990 and FY 1991 funding is associated with DOE support of IAEA? What arrangements govern this cooperation? What benefits are received from this support?

Mr. Easton. DOE maintains an active program of support to the activities of the IAEA, with special attention to development of nuclear technologies, safety, and R&D related to international safeguards. This support is largely indirect -- through provision of expert services, review of technical documents, training, participation in international technical working groups, and so forth. Funding details across the spectrum of the DOE national programs are not readily available, but we view the amounts as being nominal.

DOE also has a continuing program in "International Safeguards," funded slightly over $5 million annually. The activities include development of equipment, instrumentation, and training that serve to support the IAEA safeguards program.

Further, DOE administers funds from the State Department. The value of the activities involved is around $10 million annually. These concern a number of areas, such as training, provision of expert services, fellowships for scientific study, and the U.S. Program for Technical Assistance to Safeguards (POTAS).

The benefits yield an increased influence in international policy debates to prevent further proliferation of nuclear weapons. The nation benefits from the reduction in proliferation schemes which enhances national security. In addition, our export of nuclear equipment and safety technology is directly linked to the IAEA safeguards regime. We also use the IAEA forum to promote nuclear power safety worldwide, thereby supporting the long-term viability of the nuclear power option in the interest of energy security. DOE also keeps abreast of diverse technological efforts relevant to domestic programs relating to radiation effects and the nuclear fuel cycle.

BOARD OF CONTRACT APPEALS

Mr. Bevill. Please provide a case load analysis of the Board of Contract Appeals for FY 1989, FY 1990 and FY 1991.

Mr. Tarro. In FY 1989, the dockets of the Board of Contract Appeals and its associated boards totaled 78 cases. We estimate the FY 1990 docket will be 80 cases and the FY 1991 docket will be 80 cases. A breakdown of the case load is shown in a table which I would like to insert in the record. (The information follows:)

EBCA WORK LOAD ANALYSIS AND PROJECTIONS

	FY 1989	FY 1990	FY 1991*
BOARD OF CONTRACT APPEALS			
(a) Cases pending (Oct. 1)	48	34	40
(b) Cases filed	15	10**	40
(c) Cases disposed	31	11**	30
FINANCIAL ASSISTANCE APPEALS BOARD			
(a) Pending (Oct. 1)	2	5*	5
(b) Filed	7	1**	3
(c) Disposed	4	2**	3
CONTRACT ADJUSTMENT BOARD	0	0**	0
PATENT COMPENSATION BOARD			
(a) Pending (Oct. 1)	0	0	0
(b) Filed	0	1**	0
(c) Disposed	0	0**	0
INVENTION LICENSING APPEALS BOARD	0	0**	0
OTHER ACTIVITY			
(a) Environmental Hearings	0	0**	0
(b) Debt Collection	6	4**	0

* Estimated
** To date

BOARD OF CONTRACT APPEALS

Mr. Bevill. Describe the four major boards under the Board of Contract Appeals and provide a history and description of the cases heard by each in FY 1989, FY 1990 and FY 1991.

Mr. Tarro. The Energy Contract Adjustment Board exercises delegated Secretarial authority to hear and issue final agency decisions pursuant to Public Law 85-804 on applications for extraordinary contractual relief involving contractual fairness.

The Invention Licensing Appeals Board exercises delegated Secretarial authority to hear and issue final agency decisions on appeals from certain actions of the Department with respect to licenses, and applications for licenses, to inventions covered by patents vested in the United States which are in the custody of the Department.

The Patent Compensation Board exercises statutory authority pursuant to implementing regulations to hear and issue final agency decisions determining whether a patent is affected with the public interest and whether to grant applications for a license, royalties or compensation involving patents affected with the public interest as provided by the Atomic Energy Act of 1954.

The Financial Assistance Appeals Board exercises delegated Secretarial authority to hear and issue final agency decisions on certain disputes arising under grants, cooperative agreements, loan agreements, and loan guarantees as provided by the terms of the financial assistance instruments involved and applicable rules.

A history and description of cases heard by the Board of Contract Appeals in its various capacities during FY 1989 and FY 1990 (to date) is set forth as an attachment which is inserted as part of the record. It is anticipated that a similar mix of cases will be heard in FY 1991. No cases were heard by the Invention Licensing Appeals Board or the Contract Adjustment Board. (The information follows:)

CASE LOAD ANALYSIS
(FY 1989 and FY 1990)

Docket No.	Case Title	Relief Sought	Contract Type	Status
215-6-82	Beacon Oil Co.	$ 34,237.14	(Sale of crude	Discovery
216-6-82		$ 1,296,937.80	(oil from NPR	
345-12-83			(	Discovery
			(	Discovery
278-2-83	Powerine Oil Co., et al.	$16,520,110.07	(Sale of crude	Decided entitlement; quantum pending
280-2-83			(oil from NPR	
281-2-83			(	
282-2-83			(	
283-2-83			(	
290-6-83			(	
296-9-83			(	
300-10-83			(	
301-11-83			(	
302-11-83			(	
303-11-83			(	
304-11-83			(	
305-11-83			(	
307-12-83			(	
321-8-84			(	
328-10-84	McMillin Brothers Construction, Inc.	$ 729,281.30	Construction	Pending
337-7-85	William Powell Co.	$42,554,057.33	Supply	Settled
341-10-85				
355-5-86	Aydin Corp.	$ 3,459.878.00	Supply/Construction	Decided
358-5-86	Drillers, Inc.	$ 959,809.84	Construction	Pending

363-7-86	Newhall Refining Co., et al.	$ 171,102.00	(Sale of crude oil from NPR	Decided
364-7-86		133,575.00	(	
365-7-86		37,895.29	(	
366-7-86		63,213.37	(	
367-7-86		129,618.16	(	
368-7-86		156,377.92	(	
369-7-86		116,439.12	(	
376-9-86	Mann Construction Co.	$ 9,000.00	Construction	Decided
390-5-87	People Management, Inc.	$ 3,290,850.00	Supply/Service	Decided
397-6-87	Metroplex Industrial Constructors, Inc.	$ 342,785.02	(Construction	Decided
402-12-87			(	
403-12-87			(	
404-12-87			(	
405-1-88	EMKO Corp.	$ 73,072.00	Construction	Settled
406-1-88	Midcon of New Mexico	$ 73,566.00	Construction	Decided
408-3-88	Beaty Electric Co.	$ 114,897.28	Construction	Pending
409-3-88	Marmolejo Contractors	$ 7,184.83	(Construction	Dismissed
410-3-88		2,051.98	(	
411-4-88	Blaine-Hays Construction Co.	$ 32,355.07	Construction	Settled
412-4-88	UNC Nuclear Industries	$ 861,202.19	Services	Decided
413-5-88	EnerGroup, Inc.	$ 100,959.64	Research, development, demonstration	Settled
415-5-88	Kentucky State University	$ 9,000.00	Services	Dismissed

416-8-88	Sinclair Oil Corp.	$ 13,178.42	(Sale of crude	Decided
417-8-88		20,428.77	(oil from NPR	
418-10-88	AM-PRO Protective Agency, Inc.	$ 12,160.88	Services	Settled
419-10-88	Continental Telephone Co. of Virginia	$ 675,864.00	Supply/Services	Settled
420-10-88	Midcon of New Mexico	$ 19,676.00	Supply/Construction	Decided
421-12-88(E)	Mann Construction Co.	$ 6,473.72	EAJA request	Decided
422-2-89	Metroplex Industrial Constructors, Inc.	$ 43,676.56	Construction	Dismissed
423-2-89	Pevarnik Brothers, Inc.	(Unspecified)	Construction	Dismissed
424-3-89	Sun Pipe Line Co.	$ 293,001.93	Supply/Construction	Dismissed
425-5-89	EMKO Corp.	$ 2,279,916.10	Services/ Construction	Settled
426-6-89	Cotton & Co.	$ 1,463.71	Services	Decided
427-6-89	Pittsburgh Crane & Hoist, Inc.	$ 13,978.00	Services	Decided
428-7-89	Crain Brothers, Inc.	$ 77,460.34	Construction	Dismissed
429-7-89	Pevarnik Brothers, Inc.	$ 143,439.00	Construction	Scheduled for trial
430-7-89	Mountain States Sheet Metal Co.	$ 400,243.31	Construction	Dismissed
431-8-89	Ken Christiansen Painting, Inc.	$ 1,693,188.76	Services	Pending
432-8-89	Blaine-Hays Construction Co.	$ 73,272.00	Construction	Pending

433-11-89	Tibbetts Mechanical Contractors	$ 21,000.00	Construction	Scheduled for trial
434-12-89	Planning Research Corp.	$ 456,643.00	Services	Dismissed
435-12-89	Union Natural Gas		(Various financial (and other relief	Pending
436-12-89	Union Natural Gas		(	Pending
437-2-90	Power City Electric Co.	$ 20,735.72	State tax	Pending
438-2-90	Sletten Construction Co.	$ 17,886.93	State tax	Pending
439-2-90	Kokosing Construction Co.	$ 268,330.00	Construction	Pending
440-2-90	Sun Pipe Line Co.	$ 293,001.93	Supply/Services	Pending
441-2-90(E)	Cotton & Co.	$ 10,182.92	EAJA request	Pending
442-3-90	Wood-Leppard Contractors (Cousins Construction Co.)	$ 20,796.00	Construction	Pending

FINANCIAL ASSISTANCE APPEALS BOARD

24-6-89	Mount Mercy College	$ 25,250	Grant appeal (cost disallowance)	Decided
25-7-89	University of Puerto Rico	$ 171,871	Grant appeal (cost disallowance)	Settled
26-1-89	State of New Jersey	$1,056,893	Grant appeal (cost disallowance)	Settled
27-2-89	Confederated Tribes of the Umatilla Indian Reservation	$ 1,020	Grant appeal (cost disallowance)	Decided
28-5-89	Puerto Rico Office of Energy	$ 19,625	Grant appeal (cost disallowance)	Pending
29-6-89	School Board of Seminole County, FL	$ 14,197	Grant appeal (cost disallowance)	Settled
30-7-89	Commonwealth of PA	$ 37,125	Grant appeal (cost disallowance)	Pending
31-7-89	Rabbi Jacob Joseph School	$ 5,125	Grant appeal (cost disallowance)	Pending
32-9-89	Tunica County Hospital	(Unknown)	Grant appeal (cost disallowance)	Dismissed
33-1-90	Puerto Rico Office of Energy	$ 19,625	Grant appeal (cost disallowance)	Pending

PATENT COMPENSATION APPEALS BOARD

1-12-89	Trudeau & Haagensen	$200,000,000	Infringement	Dismissed

DEBT COLLECTION CASES

6-12-88	Martin E. Strones	$ 3,386	Travel	Decided
7-12-88	Lee LaRosa	$ 2,500	New Energy	Decided
8-1-89	Eugene F. Hoffman	$ 2,500	New Energy	Settled
9-1-89	Gary G. Johnson	$ 5,000	New Energy	Decided
10-1-89	E. Jacob McClosky	$ 2,500	New Energy	Decided
11-1-89	David R. Lee	$ 5,000	New Energy	Decided
12-11-89	Clarence Gardner	$ 7,500	New Energy	Pending
13-12-89	James A. LeFeber	$20,000	New Energy	Pending
14-1-90	Prakash Bangani	$25,000	New Energy	Pending
15-2-90	Donald C. Sarin	$12,500	New Energy	Pending

IN-HOUSE ENERGY MANAGEMENT PROGRAM

Mr. Bevill. Please describe the impact this program has had on the Department's energy requirements.

Mr. Tarro. The program's purpose is to decrease energy consumption and increase energy efficiency in the Department of Energy (DOE) facilities and operations. This is accomplished by conducting surveys and studies of DOE facilities and processes to identify retrofits and modifications, which save energy and have a high return on investment. The 10-year plan for 1986 through 1995 set goals of a 10 percent reduction in energy consumption per square foot in buildings and metered industrial and experimental processes, and a 10 percent reduction in energy consumption by vehicles and equipment from 1985 levels. The program is meeting the goals. Against the FY 1985 baseline, DOE in FY 1989 achieved a 10 percent reduction in energy consumption per square foot in buildings, a 23.9 percent reduction in energy consumption per square foot in metered processes, and a 7.2 percent decrease in energy used by vehicles and equipment.

IN-HOUSE ENERGY MANAGEMENT PROGRAM

Mr. Bevill. Describe your FY 1991 program.

Mr. Tarro. The total FY 1991 ~~request~~ for this program is $20.5 million. This will provide $3.5 million to fund surveys, studies, and utility site assessments to identify retrofit projects for future funding, and $17 million to fund approximately 75 small energy conservation retrofit projects, which when complete, will have a payback of slightly greater than 3 years.

OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

Mr. Bevill. Describe the accomplishments of your program and your FY 1991 budget request.

Mr. Tarro. Major accomplishments during FY 1989 include the operation of a centralized program that coordinates the management of scientific and technical information within the Department and provides a resource for Departmental elements to utilize in planning, developing, and implementing scientific and technical information activities; designing, developing, and implementing a computerized prototype management system for capturing and using data related to nuclear facilities incidents at Savannah River; developing a DOE-wide plan, in coordination with other Departmental elements, to implement control of computer software dissemination to sensitive countries; operation and expansion of access to the Department's on-line classified network which provides the critical communications linkage between classified data resources and the agency's defense laboratories; and managing the operation of an information program known as Energy Technology Data Exchange for the International Energy Agency, which makes valuable foreign technology available to U.S. industry and the government.

The FY 1991 budget request of $15.0 million includes $7.8 million for salaries and benefits for 175 FTEs required to manage the Department's centralized technical information program; $1.2 million for contract services

to acquire and process relevant scientific and technical information from worldwide sources which is transmitted to DOE scientists and engineers for use in the conduct of ongoing research; and $6.0 million for contract services, software, and equipment used to structure information systems that meet user, system and data requirements, and additional contract services, equipment, and supplies required to structure, process, display, and transmit data resulting from DOE's energy research.

FY 1991 BUDGET IMPACT ON RECRUITMENT AND RETENTION

Mr. Meyers: The budget for fiscal year 1991 reflects a decrease in Department of Energy Personnel compensation and benefits. What is your assessment of the impact this reduction will have on the recruitment and retention of qualified staff at the agency?

Mr. Tarro: The FY 1991 Budget in Departmental Administration shows an apparent decline in compensation and benefits for FTEs, but this is a change in budgeting philosophy rather than a real reduction in compensation and benefits for FTEs.

Traditionally within the Departmental Administration appropriation a significant percentage of the total staffing resources are devoted to direct program functions such as environmental restoration, waste management, nuclear safety, weapons programs, conservation grant programs, etc. This is because the Departmental Administration account funds the staffing for five of the field offices which oversee these programmatic activities. The Secretary has determined, as part of his initiative to change the culture within the Department and to establish better direct line management control and accountability, that staffing for specific program activities should be budgeted and controlled by the program which will be held accountable. This change in philosophy is evolving. There are several reprogramming actions being proposed in FY 1990 which begin this transition. The FY 1991 budget continues this. We fully expect the FY 1992 budget

to further this change in approach.

Therefore, the apparent reduction of benefits and compensation for FTEs in Departmental Administration is offset by equivalent increases in these same type costs throughout the Department's program budgets. The Department's overall staffing levels are expected to increase in the future and there will be no adverse impact on recruitment or retention of staff.

INTERNATIONAL COLLABORATION ON THE SSC

Mr. Myers. The Office of International Research and Development Policy has the obligation of coordinating international interest in Department of Energy initiatives. Please update the subcommittee on how effective these international collaboration efforts have been with regard to the SSC.

Mr. Easton. We have not as yet formally sought international participation in the construction of the SSC. We have had some early visits to key countries to discuss the project and solicit their interest. An international plan has been prepared, approved by an interagency group and has been discussed with the Secretary and Deputy Secretary. Consultations with industry and key members of Congress will take place prior to beginning formal discussions and negotiations with our foreign allies.

REDUCED ENRICHMENT RESEARCH AND TEST REACTOR (RERTR) PROGRAM

Mr. Myers. A Department of Energy review of the Reduced Enrichment Research and Test Reactors (RERTR) program concluded that any further research and development of new fuels would be inappropriate. What, then, are the Office of International Affairs' specific future plans for the RERTR program? Are reactor conversions the only alternatives?

Mr. Easton. Future efforts by the RERTR program will be focused on the conversion of research reactors using low-enriched fuels technology already developed. These efforts will include activities specifically related to the conversion of research and test reactors; joint study programs and safety analysis reviews; maintaining and keeping up to date the program's data base and computational abilities; evaluations requested by U.S. Government officials of the technical and economic justification for requested U.S. exports to other countries of highly enriched uranium (HEU) for research and test reactors; and, annual international RERTR meetings and other technical meetings, publications and other means of disseminating and sharing information relevant to the developed fuel status, objectives, and findings.

Alternatives other than reactor conversions could include: continued supply of HEU after careful and systematic review and approval as in the past; unilaterally restrict HEU shipments, either to or from the U.S.; or, press for the shutdown of all reactors who have not or do not intend to convert. We would like to maximize the benefits already achieved and those still achievable by concentrating our resources on the conversion of reactors for which the fuels have been developed which encompass all but a limited number of very high performance reactors. Therefore, we believe these other alternatives would not provide us with any additional benefits or advantages.

FOSSIL FUELS TECHNOLOGY TRANSFER

Mr. Myers. How effective in FY90 have the Department's international efforts to transfer technologies been, particularly to those nations which continue to utilize fossil fuels?

Mr. Easton. DOE continues to promote the use of clean coal technologies in international agreements, both to support U.S. trade interests and to help alleviate the growing environmental concerns. We have a number of bilateral agreements which have clean coal technology as an element, including ones with China, Costa Rica, Italy, Japan, Poland, and South Korea. In addition, we have several multilateral agreements under the International Energy Agency on this subject. Although we have not qualified the effectiveness, the apparent results are deemed to more than justify the Department's efforts.

NATIONAL ENERGY STRATEGY IMPACT ON THE BUDGET REQUEST

Mr. Myers. Please outline how the budget request for the Department of Energy's Office of Policy, Planning, and Analysis will impact on the development of the National Energy Strategy (NES). Describe the Secretary's proposal to monitor the implementation of the NES.

Ms. Stuntz. The FY 1991 budget request for the Policy Office includes an increase of $3,200,000 for completion of the NES and the development, implementation and maintenance of a coordinated planning, programming and budget capability that will integrate these activities horizontally across the entire range of DOE programs. This action will enable the DOE to bring plans, programs and resources into line with near, mid and long-term objectives of the NES. The increase in funding will support staff and policy studies that are needed to carry out this function.

The first phase -- information gathering -- of the NES process was concluded on April 2, 1990, with the issuance of the "interim" NES report. The public input to this report identified

49 goals, 756 options for attaining these goals, and 449 obstacles to achieving the goals. While it is by no means a complete list, it does identify many of the public concerns and divergent viewpoints regarding our future energy problems. Our task in the coming months and through FY 1991 will be to conduct policy studies in support of the NES process and to complete the report and submit it to the President by December 1990. Following submission of the report to the President, further studies will be initiated to support periodic updates of the strategy. Since most policy changes are evolutionary, these studies will support the incremental development of new policy recommendations.

To monitor the implementation of the NES, the Policy Office was reorganized by the Secretary in March 1990 and assigned new responsibilities. This reorganization established two new functions within the Policy Office to provide the day-to-day coordination and management of the NES and its subsequent implementation. One function has responsibility for the planning process and will develop a strategic planning initiative to bring DOE plans and programs into line with the NES. We anticipate a partial implementation of this initiative for the FY 1992 budget cycle, with full implementation in the FY 1993 planning and budgeting cycle.

The second new function has responsibility for coordinating the completion of the final NES report and for reviewing program budgets in relation to policy objectives, evaluating the long-term budget impact from outyear cost projections and assessing cross cutting issues and related budget support. Drawing together the implementation and coordination responsibilities for the NES and for subsequent policy goals and program plans and budgets under the Policy Office should increase the consistency of DOE budgets with national energy policies.

TO PUBLICIZE RESULTS OF R&D EFFORTS AT THE NATIONAL LABORATORIES

Mr. Myers. Secretary Watkins has announced his intention to publicize the results of research and development efforts at the National Laboratories. How will he achieve this goal and what effort will the circulation of this information have on our national security?

Ms. Stuntz. The Department of Energy has historically published the results of research and development efforts, a significant portion of which is related to basic scientific research and applied energy and not weapons research. Legislation that originally covered the Atomic Energy Commission and now DOE (such as 42 U.S.C. 5817, 1974; and 42 U.S.C. 7112, 1977) requires dissemination of unclassified and nonsensitive scientific and technical information arising from DOE research and development programs. It also provides authority for DOE to issue permits for access to restricted data by US citizens or corporations for demonstrated potential applications in the applicant's business, trade or profession. The Freedom of Information Act (FOIA) also provides that Federal agency records must be disclosed subject to specific restricted categories, such as security or trade secrets of third parties. So, the broad dissemination and publication of research results is not new for the DOE.

It is important to note that national security and economic security (e.g., U.S. competitiveness in the world market place) are closely linked. With this in mind, the recently passed National Competitiveness Technology

Transfer Act (NCTTA) of 1989 encourages the Department of Energy to re-evaluate its policies, procedures, and regulations as they relate to information dissemination, to ensure that research and technologies that can enhance U.S. competitiveness reach the broader industrial community, without compromising national security. The NCTTA also allows the DOE to place some restrictions on disseminating information that has commercial potential, in order to encourage industry participation in R&D and technology transfer.

The Department of Energy is currently evaluating all of its technology transfer policies and procedures in the light of this new legislation and as part of the National Energy Strategy. Although we do not yet have a final set of recommendations in these areas, we are considering a variety of options that will allow us to balance the following goals:

o Broadly disseminate the results of basic scientific research to encourage scientific advancement and innovation;

o Limit the dissemination of information, as necessary, to encourage domestic industry to participate in Federal R&D programs and commercialize technologies; and

o Find ways to increase industry access to technologies that are currently classified, but that may have significant commercial potential, without compromising national security.

Over the next several months, we will be working with the DOE laboratories, members of Congress, other agencies, industry, and the scientific community to evaluate various policy options and forge a consensus on mechanisms that will allow the DOE to increase the flow of Federally-funded technologies into domestic industry, for the benefit of the U.S. economy and national security.

GLOBAL CLIMATE CHANGE

Mr. Myers. The Department of Energy's Office of Policy, Planning and Analysis is in the process of completing studies on global climate change issues as requested by Congress. When do you expect the results of these studies to be made available and what do you anticipate the results to be, based upon your present collection of data?

Ms. Stuntz. The first report, A Compendium of Options for Government Policy to Encourage Private Sector Responses to Potential Climate Change, was transmitted to the Congress in January. This report analyzes over 160 specific policy measures which could be used to encourage private sector responses to potential climate change. The available professional literature and government experience with the measures are used in the evaluation.

The second report on global climate trends and greenhouse data sources is undergoing interagency review and publication is anticipated in May. The report describes current Federal data sources, and methods of dissemination. It makes recommendations for improved coordination and management to meet current and future needs.

The third report on alternative energy R&D to address greenhouse gas reductions potential is being conducted by the National Academy of Engineering for the Department. I understand completion of this report is anticipated by the Fall.

The National Academy of Engineering has established end-use panels to conduct this assessment of government energy technology R&D resources in the light of the greenhouse effect.

Finally, the last report on the costs of various options to meet specific CO_2 reduction targets is expected to be finished by the end of 1990. This report quantitatively evaluates the costs of key policy measures, both singularly and in combination. Energy technology models and macro-economic growth models are used to generate information on marginal cost curves of carbon removed.

FOREIGN PARTICIPATION IN THE SSC

Mr. Chapman. How many foreign countries has the Department visited with respect to developing an international participation plan for the Superconducting Super Collider? What kinds of agreements has the Department received from these countries?

Mr. Easton. Our past visits to foreign countries served to inform these governments about the SSC project as well to solicit from them expressions of interest in participating in the project. Countries that were visited include: Japan, Canada, the United Kingdom, France, Italy, India, Switzerland, Spain, Korea, and the Federal Republic of Germany.

Currently through an extension of the Science and Technology Initiative between India and the U.S. an annex was attached that says that the Indian Government has agreed in principle that:

"through its manpower and hardware fabrication, India may contribute in kind to the extent of U.S. dollars 50 million over a period of ten years"

This is the only document in place at this time with respect to participation by foreign governments.

Mr. Chapman. How many countries will DOE representatives visit during the present calendar year regarding foreign participation in the SSC?

Mr. Easton. We are still having internal discussions on the implementation of the international plan. As a result, we are unable to give you a specific number of countries to be visited this calendar year.

INTERNATIONAL ENERGY SECURITY

Mr. Chapman. Mr. Easton, you note in your testimony (p. 6) that your office manages international energy security programs. Could you expand on the Department's efforts in this area?

Mr. Easton. Yes, Mr. Chapman. The Department's efforts in international energy security fall into three categories: emergency preparedness, reduction of U.S. and other countries' vulnerability to interruptions of energy supplies, and reduction of market volatility.

The first category includes our activities with the International Energy Agency (IEA) emergency oil allocation program, the IEA Coordinated Early Response Measures (CERM), the U.S. Strategic Petroleum Reserve and related activities in NATO's Petroleum Planning Committee.

The second category includes a range of activities we untertake to reduce U.S. and other countries' dependence on insecure sources of energy imports, e.g. reduction of oil demand, increased energy efficiency, development of alternative fuels such as coal, gas and nuclear power. We carry out these activities in bilateral relations and in international organizations, principally the International Energy Agency.

The third category includes our efforts to maintain a dialogue with other energy producers and consumers to enrich our mutual understanding of the probable development of energy supply and demand. We do this through regular bilateral discussions with Mexico, Venezuela, Canada, Norway, Japan, Korea and several Middle East countries and through our participation in the IEA's Standing Group on Oil Markets.

WORLD OIL MARKET TRENDS IN THE 1990'S

Mr. Chapman. What key trends has the Department discovered in the area of international oil supply and demand?

Mr. Easton. I believe that we are witnessing a transition in the international oil supply/demand balance of the late 1980's, characterized by low energy prices and abundant supplies, to one with increasing demand and tightening supplies. Low world oil prices helped fuel economic growth and also encouraged growth in oil consumption. In 1988, oil demand in the market economies exceeded 50 million barrels per day for the first time since 1979.

Looking ahead into the 1990's, oil demand growth is forecast to continue, although at a slower pace. Non-OPEC production is expected to plateau in the early 1990's, leaving OPEC as the sole supplier of marginal demand. OPEC is currently producing between 80 - 85% of capacity, and although some members have announced plans to expand production capacity, there will be a lead-time before this additional production capacity is operational, during which we can expect to experience a tight supply situation. Recent changes in the Soviet Union and Eastern Europe could also strain the system, as demand in the region is expected to grow, while Soviet supply is simultaneously expected to decline.

United States oil consumption is expected to continue growing, adding about 1.6 million barrels per day of demand by the year 2000. Over the same period, domestic production will continue to decline. U.S. imports are expected to increase to over 50 percent of consumption by 1995 and 55 percent by 2000.

The Department will be monitoring the impacts on the U.S. petroleum infrastructure of our changing supply balance including: increasing demand for tankers to transport imports, new port facilities to accommodate imports, ample petroleum pipeline capacity, and adequate refining capacity.

NATURAL GAS MARKET ANALYSIS

Mr. Chapman. Can you describe in more detail the Department's natural gas market analysis and your goals with regard to this program?

Ms. Stuntz. The Department of Energy (DOE) believes that demand for natural gas will increase in the next decade for several reasons. First, natural gas can make greater contributions to the Nation's energy security. In many applications, natural gas can be substituted economically and easily for oil, thus lessening the need to import oil from potentially insecure sources. Natural gas can also help meet environmental goals. At a time of growing concern over the pollution of our Nation's air and water, natural gas provides a clean-burning fossil energy option. Additionally, natural gas will likely play a larger role as a fuel for generating electricity. The Energy Information Administration estimates that natural gas consumption by electric utilities will double by the year 2000.

The Department conducts a variety of analyses of the natural gas sector. With regard to natural gas supply, DOE's main objective is to obtain accurate information on the natural gas resource base. It is generally agreed that the U.S. is endowed with a large natural gas resource base. DOE has estimated that the Nation has a 35-year supply of natural gas at consumption rates of 17 trillion cubic feet (tcf) a year, and at prices of $3.00 per thousand cubic feet (mcf) or less. At prices in the range of $3.00 - $5.00 per mcf, our supplies would extend far longer.

While the resource base is large, the delivery infrastructure from

wellhead to burnertip must be sufficient to assure that reliable supplies of natural gas are available to consumers. The Department expects to undertake a study of the deliverability of natural gas at the wellhead, and to participate in a study conducted by the Federal Energy Regulatory Commission on pipeline deliverability.

Additionally, DOE tracks the impact of deregulation and competition on the natural gas industry and on end users. During the last decade, the Federal Energy Regulatory Commission has taken many actions designed to promote competition and deregulate the natural gas marketplace. Last year, the Congress enacted the Natural Gas Wellhead Decontrol Act of 1989, which will completely decontrol the price of natural gas at the wellhead by 1993.

Additional statutory and regulatory reforms are desirable. DOE has testified that further reform should focus on three areas: making new pipeline capacity available, providing proper pipeline rate incentives, and eliminating unnecessary regulation of pipeline gas costs. DOE will be undertaking further analytic work on these issues in conjunction with the development of the National Energy Strategy.

Finally, DOE continues to analyze the role that natural gas can play as an alternative fuel for transportation, where gas-derived fuels are likely to become increasingly important in meeting clean air objectives.

FEDERAL FUNDING FOR ENHANCED OIL RECOVERY RESEARCH

Mr. Chapman. With respect to the ongoing development of a National Energy Strategy, what role does the Department envision for enhanced domestic oil and gas production techniques in strengthening our energy security. What initiatives has the Department taken to encourage enhanced oil recovery and unconventional gas recovery?

Ms. Stuntz. There is enormous potential for application of enhanced oil recovery (EOR) techniques in U.S. producing areas, given the fact that only about one third of the oil in reservoirs can be removed using primary and secondary recovery methods. Although many EOR projects have proved successful in the laboratory and in commercial applications, EOR currently provides less than 10 percent of total U.S. production. One reason for this is that the current level of oil prices does not encourage widespread application of the more costly EOR techniques. Another reason is the lack of technical knowledge about the best methods for applying EOR techniques to different reservoir formations and types of crude oil.

The DOE Enhanced Oil Recovery Program is based on the premise that through successful research, a significant portion of the remaining two-thirds of the oil in place can ultimately be recovered. The Department has requested $27.3 million for research on EOR in Fiscal Year 1991. About 80 percent of this funding will go to EOR research on light oil (oil from reservoirs that have undergone conventional production) and 20 percent will

go to EOR research on heavy oil (oil that is too viscous for any primary or secondary recovery).

The Department is funding research targeted at recovery of two categories of oil. One target is "mobile" oil that can be moved within a reservoir by waterflood technology but cannot be extracted without a better understanding of the reservoir structure. DOE research will help develop new tools to measure directional permeability and define reservoir geometry by improving current methods of reservoir data collection.

The other type of oil targeted for DOE research is "immobile" oil that requires physical or chemical stimulation for production. The Department is funding studies to improve producers' ability to locate residual oil trapped in reservoirs and to better understand what causes the oil to be immobile.

The Department emphasizes private industry and State government participation in its EOR research program. Approximately 57 percent of all EOR projects are cost-shared, usually with about 50 percent of the costs funded by industry. Cost sharing lowers research costs for the Federal Government and facilitates the transfer of technology.

EXPORT OF U.S. PETROLEUM TECHNOLOGY TO THE SOVIET UNION

Mr. Chapman. Ms. Stuntz, you stated in your testimony (p.9) that the Department "assessed the potential for the transfer of American petroleum exploration and production technology to the Soviet oil and gas industry...to maintain the U.S. leadership in this technology." What was the result of this assessment? What potential do you see for such exports?

Ms. Stuntz. The Office of Policy, Planning and Analysis has assessed the potential for the U.S. oil and gas technology exports to the Soviet Union. The conclusion was that the underdeveloped Soviet energy market offers major opportunities for the U.S. petroleum service industry. After years of discouraging foreign involvement in its energy sector, the Soviet Union is now looking to the U.S. and other Western Nations for assistance.

The Soviet petroleum industry generally lacks adequate equipment and technology. Imports of equipment such as rotary drilling rigs, deep drilling equipment, tubular goods, blow-out preventers, and pumping equipment are needed.

In addition, joint ventures for oil and gas exploration and development clearly are attractive from the Soviet perspective. They limit debt incurred by the Soviets if foreigners invest most of the necessary capital. They also facilitate the transfer of management know-how to the Soviet industry, as well as improved technology. The Soviets have expressed particular interest in enhanced oil recovery techniques to extract more oil from mature fields and in developing production areas in the Arctic.

Soviet planners are concerned increasingly with the technological aspects of extraction and development drilling, such as improving maintenance to bring idle oil and gas wells back on-line, expanding secondary recovery (especially gas-lift methods), and increasing drilling speeds to reduce the time of well construction.

The amount of U.S. involvement in the Soviet market will depend on the successful resolution of the several basic problems facing any company entering the Soviet market, such as the non-convertability of the ruble, the difficulty of transferring profits in hard currency out of the Soviet Union, access to raw materials, protection of intellectual property rights, and development of an effective arbitration mechanism for settling commercial disputes. Another important factor affecting U.S. technology exports is the outcome of the current U.S. reevaluation of policies and procedures for tariff treatment, export controls, and export financing assistance.

IMPACT OF SEQUESTRATION

Mr. Conte. What impacts has sequestration had on the Department's administrative accounts in FY 90 ?

Mr. Tarro. Because the Department took steps in the first quarter of FY 1990 to operate at a reduced rate in anticipation of a full-year sequestration on the order of 4.3 percent, the actual sequestration of 1.5 percent for defense programs and 1.4 percent for non-defense programs has been accommodated within our administrative accounts primarily through reductions in travel and training. Contractual services were also scrutinized carefully to eliminate all but the most critical components. Through careful management, reductions-in-force were avoided.

DEPARTMENTAL ADMINISTRATION

Mr. Conte. Does DOE conduct any department-wide programs to prevent or eliminate the use of illegal substances? If so, please describe these programs and quantify their costs and effects.

Mr. Tarro. Yes. DOE has a Federal program in place and is planning a program for DOE contractors.

DOE Federal Program

In accordance with Executive Order 12564, DRUG-FREE FEDERAL WORKPLACE, dated September 15, 1986, the DOE established a comprehensive program to achieve a drug free workplace. The Department's program is described in a Departmental directive, DOE Order 3792.3, DRUG-FREE FEDERAL WORKPLACE TESTING IMPLEMENTATION PROGRAM, dated July 29, 1988.

DOE's program includes a statement of policy indicating that DOE will help employees who use illegal drugs but that it will not tolerate the use of illegal drugs in the workplace and that the sale, use, or possession of illegal drugs, whether on or off duty, is not consistent with Federal employment and may be ground for disciplinary action, up to and including removal. In addition, DOE's program includes an Employee Assistance Program offering counseling and rehabilitation services to employees using drugs, supervisory training to help supervisors identify and address illegal drug use, and drug testing to determine if illegal drugs are being used by employees in sensitive positions. The testing program covers approximately 1000 Federal employees.

In 1989 the DOE Federal Drug-Free Workplace Program cost $35,986.00. In 1990, it is estimated to cost $176,830.00. Since testing began in March 1989, we have conducted 214 drug tests of which only 1 has been positive for the use of illegal drugs.

DOE Contractor Program

The Department of Energy (DOE) plans that the major contractors responsible for managing and operating DOE's facilities will be required to institute a substance abuse program similar to that made applicable to DOE Federal employees. The contractor program is in draft form and is completing a period of internal DOE review and comment. It is anticipated that the program will be published as a Notice of Proposed Rulemaking in the Federal Register in the near future.

The proposed contractor program will be applicable to DOE's Management and Operating contractors and other contracts or subcontracts which the DOE Heads of Contracting Activities determine should be included. The contractor program will require that contractors provide substance abuse training, and an employee assistance program for their employees.

Applicants for certain sensitive positions will receive a urine drug analysis to determine the use of illegal drugs, and incumbents of those sensitive positions will be randomly tested via a urine drug analysis for use of illegal drugs. In addition all employees of affected contractors will be subject to "for cause testing" (either due to an accident/incident or due to reasonable suspicion) for substance abuse (illegal drugs as well as alcohol and legal drugs).

The Department now has a rough approximation of the effects of this program. It is anticipated that approximately 160,000 contractor employees will be subject to the total program, and of those, 40,000 may be subject to random testing for use of illegal drugs. The cost of implementing such a program is anticipated to be $8 million annually. DOE plans that the contractor substance abuse program will be implemented by the end of 1990.

IN-HOUSE ENERGY MANAGEMENT PROGRAM

Mr. Conte. Please update the Subcommittee on the status of the In-house Energy Management Program.

Mr. Tarro. The Department consumed 53.9 trillion Btu's during FY 1989, in the buildings category. This is a 1.7 percent decrease over the FY 1985 baseline. The Department's average square feet in buildings for FY 1989 was 77.1 million, 6.5 million more square feet than in FY 1985, or a 9.2 percent increase. The goal is measured in energy consumption per gross square foot to adjust for changes in facilities' spaces. Measured against this goal the Department reduced energy consumption per square foot in buildings by 10 percent in FY 1989. The cost of the energy used in buildings in FY 1989 was approximately $179.5 million or $1.1 million less than in FY 1985 or a 0.1 percent decrease.

The Department consumed 33.2 trillion Btu's during FY 1989 in the metered process category. This is a decrease of 15 percent from the FY 1985 baseline. The Department's average square feet in metered process for FY 1989 was 16.2 million, 1.6 million more square feet than in FY 1985 or an 11.1 percent increase. The goal for the metered process category is also measured in energy consumption per square foot to adjust for changes in facilities' spaces. The Department reduced its energy consumption per square foot in metered process by 23.9 percent in FY 1989. The cost of energy used in metered process in FY 1989 was approximately $120.1 million or $20.9 million less than FY 1985 or a 14.8 percent decrease.

The Department consumed 2.2 trillion Btu's in the vehicles and equipment category. This is a 7.2 percent decrease from FY 1985. The cost for energy used in this category is $16.2 million or $5.9 million less than in FY 1985 or a 26.9 percent decrease.

STRATEGIC FACILITIES UTILIZATION PROGRAM

Mr. Conte. Please report on the progress of the Strategic Facilities Utilization Program since your last appearance before this Subcommittee.

Mr. Tarro. As of January 31, 1990, $2,605,292 worth of disposal work had been completed. This equates to 55 unneeded facilities demolished or removed; resulting in operating and maintenance cost avoidances calculated at over $1.3 million per year.

JET INDUSTRIES PROPERTY

Mr. Conte. Has the Department sold the 76 acres of property that it has a right to sell under a negotiated agreement with Jet Industries, which defaulted on an electric vehicle guaranteed loan? If, so, what were the proceeds from the sale? If not, do you anticipate that the property will be turned over to the General Services Administration for liquidation?

Mr. Tarro. The Department has not sold the property. Under the Agreed Order, which was entered in the United States District Court on October 6, 1987, Jet Industries (Jet) has the exclusive right until September 1, 1990, to close a sale of all or part of the property at a price sufficient to pay the Department $1,531,717, plus interest on the principal sum of $531,818 accrued to the date of payment. In the event the Department has not been paid the amount specified by the court by September 1, 1990, the Department shall retain the land free and clear of any claims by Jet, and the Payment Amount owed the Department at the time shall be considered paid in full by DOE's retention of the land in satisfaction of the debt. DOE then has the right to retain, use or dispose of the land as it alone chooses, and all proceeds from any sale of the land after September 1, 1990, shall be paid to and belong solely to the Department. In that event, the Department would take appropriate action to dispose of the property either itself or through the General Services Administration.

DEPARTMENT OF ENERGY

LIST OF WITNESSES BEFORE THE
SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT
COMMITTEE ON APPROPRIATIONS
HOUSE OF REPRESENTATIVES

FISCAL YEAR 1991 BUDGET REQUEST

DEPARTMENTAL ADMINISTRATION

MARCH 15, 1990

PRINCIPAL WITNESSES

Jim E. Tarro
Acting Director,
Administration and Human Resource Management

Jacqueline Knox Brown
Assistant Secretary
Congressional And Intergovermental Affairs

John C. Layton
Inspector General

Melva Gibson Wray
Director, Office of Minority Economic Impact

Stephen A. Wakefield
General Counsel

John J. Easton, Jr.
Assistant Secretary
International Affairs and Energy Emergencies

Linda G. Stuntz
Deputy Under Secretary
Policy, Planning and Analysis

Mary Joy Jameson
Acting Director of Public Affairs

U.S. Department of Energy
Office of the Secretary
Washington, D.C. 20585
202/586-5534

BIOGRAPHY

JIM E. TARRO

Jim E. Tarro was appointed Acting Director for Administration and Human Resource Management, U.S. Department of Energy (DOE) on March 1, 1990. In this position, Mr. Tarro reports to the Under Secretary of Energy to provide managerial and administrative oversight, control functions and centralized policy direction.

Mr. Tarro's principal areas of responsibility are organization and management systems; personnel management; equal employment opportunity; automated data processing management and acquisition; telecommunications management; technical information and inhouse energy management; program project construction and facility management; and, headquarters administrative services.

Before accepting this position, Mr. Tarro was the Principal Deputy Assistant Secretary for Management and Administration at DOE. Prior to that, he served eight and a half years at Digital Equipment Corporation in Albuquerque, New Mexico, serving as the Assembly Engineering Manager, and most recently as the Plant Quality Manager. His professional experience includes three years in research and development, and twenty-five years in manufacturing, design engineering, production management, quality engineering, industrial engineering, quality management, master planning, personnel positions (labor/employee relations, compensation administration, employment and training) and many cross-functional project management responsibilities with materials, inventory, procurement, distribution, finance and management information systems.

Mr. Tarro holds a vocational certificate in Electronic Technology from the U.S. Navy. He received B.A. degrees in Political Science and Urban Studies from California State University at Northridge, California, and a M.A. in Social Behavior Sciences from Azusa Pacific University.

Throughout his career, Mr. Tarro has been very active in his community, as evidenced by the following honors/awards and offices that he held:

- Voted the National Hispanic Engineer of the Year (1984), and was given the most coveted and prestigious recognition for a Hispanic professional, the Jamie Oaxaca Award;

(more)

- Chairman for the Executive Advisory Council to the Society of Hispanic Professional Engineers;
- Founder and President of the Society of Hispanic Professional Engineers, New Mexico Chapter;
- Member of the Board of Directors and Executive Committee for the Albuquerque Hispano Chamber of Commerce;
- Vice President of Internal Affairs for the Hispano Chamber of Commerce;
- President and Chairman of the Board of New Mexico MESA; and,
- a Manufacturing Representative to RIOTECH.

March 1990

Statement of Jim E. Tarro
Acting Director
Administration and Human Resource Management
Department of Energy
FY 1991 Appropriations Hearing

Mr. Chairman and Members of the Subcommittee, I appreciate the opportunity to appear before you today to discuss the Fiscal Year (FY) 1991 Congressional budget request for the Departmental Administration Appropriation. This includes the Office of the Secretary; the Offices of Administration and Human Resource Management, Financial Management and Controller, and Procurement and Assistance Management; five multi-purpose Operations Offices nationwide; as well as the financial accounts of Cost for Others and Revenues; General Counsel; the Board of Contract Appeals; the Office of Minority Economic Impact; the Office of Policy, Planning and Analysis; Congressional Affairs; Public Affairs; and the Office of International Affairs. The Inspector General is no longer funded from Departmental Administration since it now has its own appropriation.
I will also discuss the In-House Energy Management, the Technical Information Management, and the Strategic Facilities Utilization Programs requested in the Energy Supply Research and Development Appropriation.

Testimony will be presented by principal spokespersons for the other major areas within Departmental Administration. Accompanying me today are: Jacqueline Knox Brown, Assistant Secretary for Congressional and Intergovernmental Affairs; John C. Layton, Inspector General; Melva G. Wray, Director of Minority Economic Impact; Stephen A. Wakefield, General Counsel; John J. Easton, Jr., Assistant Secretary for International Affairs and Energy Emergencies; Linda G. Stuntz, Deputy Under Secretary for Policy, Planning and Analysis; and Mary J. Jameson, Acting Director of Public Affairs.

ACCOMPLISHMENTS

Mr. Chairman, before I present an overview of Departmental Administration's FY 1991 budget, I would first like to take this opportunity to highlight a few of the significant accomplishments we have achieved during the past year.

- Initiated a proposed rule (published in the Federal Register, dated January 26, 1990) to revise the Department's policy on indemnification.
- Modified the award fee criteria in contracts for operation of the defense production facilities to increase emphasis on environment, safety and health programs.
- Provided coordination and staff support to the Office of the Secretary for implementation of high priority Secretarial initiatives to strengthen Departmental line management authority and accountability for environment, safety and health aspects of program execution.
- Established a capability (Computer Incident Advisory Capability) to assist Departmental sites in responding to computer security incidents.
- Served as a pilot agency to develop a mainframe to mainframe link to Treasury's financial management system for the purpose of electronically transmitting year-end financial statements for the Department.
- Implemented the Departmental Integrated Standardized Core Accounting System (DISCAS) at the Federal Energy Regulatory Commission (FERC) and completed a core compliance review to further standardize DOE's accounting system.
- Developed a program plan and implementation schedule for the Drug Free Federal Workplace Testing and Education Program.
- Implemented the Department's Integrated Security System for nationwide operational use. Allows centralized tracking of the status of all DOE and contractor clearances, and visits for classified purposes by U.S. citizens at each DOE facility.
- Designed, developed, and implemented a computerized prototype management system for capturing and using data related to nuclear facilities incidents. This system contains data on Savannah River incidents, and expansion to other reactor sites is anticipated.

OVERVIEW

The FY 1991 budget request for Departmental Administration is $424.2 million, which is composed of $308.1 million for administrative operations and $116.1 million for the Cost of Work for Others program. The administrative operations request includes $162.4 million for salaries and related expenses, as well as $145.7 million for support services and capital equipment. In addition, the Cost of Work for Others program, under DOE's full-cost recovery concept, will generate $124.0 million in revenues. An additional $59.4 million in other revenues will be generated from the sale of incidental by-products. There is also $16.4 million in unobligated balances from FY 1989 that is being deferred into FY 1991 to reduce the budget authority requirement in the Departmental Administration account.

The total funding request for activities managed by the Office of Administration and Human Resource Management, but funded from the Energy Supply Research and Development Appropriation, is $38.5 million. This includes: $20.5 million for the In-House Energy Management Program, $15.0 million for the Technical Information Management Program and $3.0 million for the Strategic Facilities Utilization Program.

OFFICE OF THE SECRETARY

The Office of the Secretary assures the formulation, implementation, and articulation of energy policies, regulations, and legislation as mandated by the President and enacted by Congress. The FY 1991 budget request for the Office of the Secretary is $3.9 million for salaries, benefits, and travel expenses.

ADMINISTRATION AND HUMAN RESOURCE MANAGEMENT, FINANCIAL MANAGEMENT AND CONTROLLER, AND PROCUREMENT AND ASSISTANCE MANAGEMENT

These Offices provide a wide range of institutional support services to all headquarters program elements and to the Department as a whole. Major management concerns include personnel and manpower; organization, administrative, and operational systems; construction projects and facilities; logistics, building, library, and printing operations; automated data processing and telecommunications; contractor human resources management; finance, accounting, and budget; procurement and contract administration; and equal employment opportunity activities. The FY 1991 budget request for the Offices of Administration, Controller and Procurement is $159.4 million.

This includes $56.5 million for salaries and benefits; $1.9 million for related travel expenses; and $101.0 million for contractual services and capital equipment in the multiple support areas mentioned above.

OPERATIONS OFFICES

Five of the eight Operations Offices are multi-program and are funded within the Departmental Administration Appropriation. These are Chicago, Idaho, Oak Ridge, Richland, and San Francisco. The Operations Offices' field role includes increasing energy efficiency, fortifying scientific foundations, respecting the environment, and strengthening national defense. Of the $109.4 million requested in FY 1991, $72.5 million is for salaries and benefits; $2.6 million for travel expenses; and $34.3 million for contractual services and capital equipment to perform a wide variety of

functions in support of energy activities throughout the country. These functions include procurement and contract administration, health and safety monitoring, property management, labor relations, and maintenance of personnel and financial systems. The Operations Offices plan, develop, and administer budgets as well as provide oversight and support to a full spectrum of DOE programs and projects. The Operations Offices have cognizance over the activities of an estimated 71,000 contractor employees, located at various DOE facilities, who are engaged in essentially all aspects of the Department's research and development programs. The other three Operations Offices primarily support defense activities and are funded by the Atomic Energy Defense Appropriation. These are Albuquerque, Nevada, and Savannah River.

COST OF WORK FOR OTHERS AND REVENUES

Cost of Work for Others covers expenses for products and services to non-DOE domestic and foreign entities when such products or services are not readily available from alternate sources. Examples of such products and services include special materials; activities related to the weapons program; specialized research and testing in areas such as photovoltaics, high temperature superconductivity, effects of fossil fuels, and steam generators; and timber sales and management.

The FY 1991 estimate for the Cost of Work program is $116.1 million. The Department will receive an estimated $12[illegible].0 million in Associated Revenues as full-cost recovery reimbursement for this work. Miscellaneous Revenues estimated at $59.4 million are also earned from the sale of incidental by-products that have no costs associated with the Departmental Administration appropriation, but rather to activities funded from other Departmental programs.

IN-HOUSE ENERGY MANAGEMENT

The goal of the In-House Energy Management Program is to reduce energy consumption and utility and energy costs at DOE owned facilities. The FY 1991 request of $20.5 million reflects a continuing investment to improve the energy efficiency of DOE buildings, facilities, and processes through quick payback retrofit projects. The program of retrofits proposed for FY 1991 is comprised of projects that typically have a payback period of approximately three years or less and a rate of return exceeding 30 percent per year of the dollars invested. The In-House Energy Management Program is centrally planned and coordinated, which enables the Department to achieve maximum efficiency and effectiveness by competing projects DOE-wide on the basis of return on investment and energy savings. The proposed funding also continues energy conservation surveys to identify future retrofit projects and to identify no or low cost operational changes to reduce current energy consumption.

TECHNICAL INFORMATION MANAGEMENT PROGRAM

The Technical Information Management Program (TIMP) provides centralized scientific and technical information management and dissemination for use by DOE and other Federal and State agencies as well as the academic, scientific, and business communities. The responsibilities of this program are the development of specific DOE-wide policies, procedures, and guidelines for the management of DOE's scientific and technical information; oversight and program evaluation to ensure that research and development information resources are effectively managed; management of an international program to facilitate the exchange of information between

nations generated through world-wide energy research and development; and management of the Office of Scientific and Technical Information, DOE's centralized scientific and technical information facility. The FY 1991 budget request for the Technical Information Management Program is $15.0 million.

STRATEGIC FACILITIES UTILIZATION PROGRAM

The Strategic Facilities Utilization Program reduced maintenance dollars by disposing of facilities that were no longer needed. This program has helped highlight the Department's need for better data from which to create an integrated capital assets management program. In FY 1991, this program will focus on developing a consistent Department-wide set of standards and methods for performing facility condition assessment surveys. This will determine which facilities are in need of replacement, refurbishment or demolition. Actual work on the facilities will then be funded, as necessary and appropriate through the operating programs. The FY 1991 budget request for this program is $3.0 million.

Mr. Chairman, this concludes my presentation. Mrs. Brown is prepared to speak to the activities of the Office of Congressional and Intergovernmental Affairs.

U.S. Department of Energy
Office of the Secretary
Washington, D.C. 20585
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BIOGRAPHY

JACQUELINE KNOX BROWN

Jacqueline Knox Brown was nominated by President Bush to be the Assistant Secretary for Congressional and Intergovernmental Affairs, U.S. Department of Energy, in June 1989 and confirmed by the Senate on October 5, 1989. In this position, Mrs. Brown is responsible for directing the Department's legislative programs, as well as liaison activities with members of Congress, state and local officials and industry representatives.

Prior to joining the Department of Energy, Mrs. Brown was a Senior Policy Analyst with the Commission on Executive Legislative and Judicial Salaries.

In October 1987, following fifteen years as a staffer on Capitol Hill, Mrs. Brown joined the Presidential Commission on the Human Immunodeficiency Virus Epidemic as a Senior Policy Analyst.

From 1972 to 1987, Mrs. Brown served in a number of Congressional staff positions, including Office Manager and Research Assistant for the House Wednesday Group, Legislative Assistant to Senator Thad Cochran (R-MS), and Minority Staff Director on the Subcommittee on Aging of the Senate Committee on Labor and Human Resources.

A native of Washington, D.C., Mrs. Brown received her B.A. degree in Economics from Howard University. She is married to Henry (Hank) Brown, has a daughter, Danita Knox, and a son, Aaron Knox Brown.

March 1990

Statement of Jacqueline Knox Brown
Assistant Secretary
Congressional and Intergovernmental Affairs
Department of Energy
FY 1991 Appropriations Hearing

Mr. Chairman and Members of the Subcommittee:

I appreciate this opportunity to appear before you today to discuss the FY 1991 budget request for the Office of Congressional and Intergovernmental Affairs.

Our Office performs a broad range of liaison and outreach activities. One of our primary responsibilities is to work with Members of Congress and their staffs to keep the Congress informed about the activities of the Department of Energy. We are well aware of the need to maintain close working relationships with you and other Members of Congress on Departmental programs and initiatives. Recently, we implemented a proactive system for working with state and local government officials as well as the private sector to ensure that other levels of government and interested parties have a thorough understanding of the Department's goals and objectives. For example, we have ensured that the process of developing the Department's National Energy Strategy has allowed for the involvement and input of Members of Congress, Governors, State representatives and others who are impacted by our programs and policies.

In FY 1991, we plan to enhance the activities of our office by playing a more active role in coordinating the Department's major policies, program

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decisions and announcements with the Congress. Providing information to the Congress in a timely manner continues to be our priority.

The budget request for the Office of Congressional and Intergovernmental Affairs for FY 1991 is $3,825,000. Our FY 1991 budget requests calls for $3,780,000 for salaries and expenses and a continuation of a personnel level of 69 Full-Time Equivalents (FTEs). This funding level allows for adequate staff to meet the Office's wide range of responsibilities. During this past year, we have undertaken a number of additional responsibilities within the Department, particularly regarding the Department's system for responding to questions and other requests from Members of Congress following hearings.

A total of $45,000 is requested for contractual support. These funds will provide for dissemination of consumer energy information through radio announcements and bi-monthly news columns on major energy programs and policies.

Mr. Chairman, in response to this Subcommittee's request, I would like to give you an overview of some of our activities for the remainder of this fiscal year.

FY 1990 ACTIVITIES

This year we have been very involved with the Secretary and his programmatic Assistant Secretaries on a number of important issues. Many of these relate to weapons productions, environmental restoration, health, safety and waste

management issues. In addition we are providing research, analyses and liaison services on:

- o Clean Air legislation
- o Global Climate Change proposals
- o A Conservation and Renewable Energy Initiative
- o A study on the viability of a Uranium Enrichment Corporation

This Office will be conducting many other outreach activities such as:

- o Providing for increased access for Congressional staffers to DOE program officials.
- o Conducting briefings to ensure that Members of Congress and their staffs are informed about Departmental programs and policies prior to public announcement.
- o Monitoring activities of state legislatures and state and local legislators.
- o Attending conferences and other events sponsored by energy industry organizations.
- o Tracking energy-related legislative initiatives of other federal agencies.

To accomplish our objectives, I have reorganized the operations of the Office to be more responsive and timely in carrying out our responsibilities. This reorganization establishes a clear-line of authority for liaison with the House of Representatives, the Senate and inter- and non-governmental entities,

with ultimate responsibility resting with me. This reflects Admiral Watkins' approach Department-wide to inject a greater level of accountability and responsiveness into Departmental activities. I believe this will enhance communications between Congress and the Department of Energy.

The following table summarizes the FY 1991 request:

	(Dollars in Thousands) FY 1991
Salaries & Expenses....	$3,780
Program Support.....	45
Total	$3,825

In closing, I want to mention that it has been a great privilege and pleasure to work with the Congress since my confirmation last October. On behalf of the Department, we look forward to a continuing and productive relationship.

U.S. Department of Energy
Assistant Secretary for
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and Public Affairs
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BIOGRAPHY

JOHN C. LAYTON

John C. Layton was nominated by the President on November 14, 1985, and confirmed by the Senate on December 16, 1985, as the Inspector General for the U.S. Department of Energy (DOE). In this position, he is responsible for the coordination, supervision, and management of audits, investigations and inspections of all Departmental activities, including those of the Federal Energy Regulatory Commission, to ensure honest and efficient management.

Prior to accepting his current position, Mr. Layton served as Inspector General at the Department of the Treasury. In 1980 he joined the National Aeronautics and Space Administration's (NASA) Inspector General staff as Director of Investigations at the Goddard Space Flight Center in Greenbelt, Maryland, and was NASA's Deputy Inspector General from 1983 to 1984.

In 1972, Mr. Layton joined the FBI as a Special Agent. During his tenure with the FBI, he was detailed to the Surveys and Investigations Staff of the Committee on Appropriations of the U.S. House of Representatives and to the U.S. Senate Committee on Appropriations Investigations Staff. He began his career as an auditor for Litton Industries, Inc. in 1966.

A native of East Stroudsburg, Pennsylvania, Mr. Layton received his B.S. degree in commerce (accounting major) from Rider College in 1966. He was an officer in the U.S. Army Finance Corps from 1967-1969.

Mr. Layton has served as: Treasurer and Member of the Board of Directors of the Association of Federal Investigators from 1980-1985; a Director of the Association of Federal Investigators Endowment Fund from 1985-1988; Chairperson of the Ethics Board of the Association of Government Accountants in 1985; and also a member of the Society of Former Agents of the FBI since 1980.

Mr. Layton currently resides in Woodbridge, Virginia.

February 1989

Statement of John C. Layton
Inspector General
Department of Energy
FY 1991 Appropriations Hearings

Mr. Chairman, I am pleased to have this opportunity to address this Subcommittee. I am John C. Layton, the Inspector General of the Department of Energy.

RESPONSIBILITIES

Effective April 16, 1989, The Inspector General Act Amendments of 1988, P.L. 100-504 transferred the authority of the Department of Energy Office of Inspector General from Section 208 of the Department of Energy Organization Act, 42 U.S.C. 7138, to the Inspector General Act of 1978, P.L. 95-452, as amended, 5 U.S.C. App.3. Enactment of P.L. 100-504 did not change the fundamental goals and objectives of this Office.

The statutory responsibilities of the Inspector General, as stated in Section 4 of Public Law 95-452, as amended, The Inspector General Act of 1978, are to detect and prevent fraud and abuse and to promote economy and efficiency in the programs and operations of the Department of Energy (DOE). These programs encompass the work of over 16,800 employees of the Department, over 131,600 DOE contractor employees at Government-owned, contractor-operated facilities, and the activities of other contractors and grantees of the Department.

The DOE is a complex and multi-missioned Department, second only to the Department of Defense (DOD) in the dollar amount of its procurement activity. The DOE contributes to the national defense through the production of nuclear weapons and materials in response to the DOD requirements. It operates a variety of production and research facilities with many different missions. It is the Department's policy to protect the environment, Government property, safety and health of the DOE employees and the public. In addition, the DOE is responsible for the development of deep underground repositories for the disposal of spent nuclear fuel and high-level radioactive waste in a manner that protects the public safety and health. Thus, the audit, investigative, and inspection requirements of the DOE Inspector General's Office are extensive and varied.

ORGANIZATION

- Audits, Investigations, Inspections & Analysis -

The Office of Inspector General (OIG) is comprised of three divisions. An Assistant Inspector General is responsible for each division. The Office of Audits performs all internal audits for the Department and conducts financial and performance audits. The Office of Investigations is responsible for the prevention and detection of fraud and abuse in the programs and operations of the Department by conducting investigations. The Office of Inspections and Analysis conducts reviews of major DOE programs, projects and systems and responds to inquiries that assist in

meeting the strategic objectives of the OIG. In addition, the Office of Executive Director performs administrative functions for the OIG including operating an independent personnel office. The OIG is headquartered in Washington, D.C., with personnel assigned to 16 field offices around the country. This organization enables us to provide oversight of the various DOE facilities.

The Office of Audits is assigned 128 FTEs in FY 1990 with no increases projected for FY 1991. During FY 1989, Audits undertook an ambitious campaign to hire 30 entry level auditors through recruitment at colleges and universities. Most of these auditors were brought on in the last part of the fiscal year and are currently undergoing both formal and on-the-job training. This group represents a talented cross section of recent accounting graduates and should contribute significantly to our in-house capabilities in FY 1990 and beyond.

The Office of Investigations is in the process of hiring 25 additional full-time investigators which will increase its staff resources to 67 FTEs in FY 1990. Of the 25 new hires, two are supervisory Special Agents. One of the new positions will provide for a Supervisory Special Agent to oversee all investigative cases involving environmental, safety, and health issues. The remaining 23 new hires will be assigned to field offices throughout the country.

The Office of Inspections and Analysis is assigned 18 FTEs in FY 1990 with a request for 16 additional FTEs in FY 1991 for a total of 34. Inspections and Analysis currently has two divisions, the Headquarters Division and the Field and Special Operations Division. We plan to create a third division. The primary purpose of this third division will be to perform reviews of the DOE's Operations Offices, Area Offices, Programs, Power Marketing Administrations and Headquarters organizations. These reviews will enable us to determine if policies and procedures are in place and being implemented to ensure effective program management by the DOE. These additional positions will provide Inspections and Analysis with improved capabilities to monitor the Department's programs and respond in a more effective manner to requests from the public, Congress, Departmental management and concerned employees to review potential areas of concern that may exist within the Department. They will provide a core staff to perform the reviews discussed above with some augmentation from the field staff.

In compliance with Quality Standards for Federal Offices of Inspector General, established by the President's Council on Integrity and Efficiency, we have established a Quality Assurance Program within the OIG. This Program involves multidisciplinary teams who review the OIG components to ensure that audit, investigation, inspection and administrative activities conform with law as well as established performance standards, the OIG policies and procedures and other requirements, and that they are carried out economically, efficiently and effectively. This program has

improved operations and strengthened internal controls. It has also promoted the sharing of information among staff members on how to perform more effectively.

We began using contractors to perform audits in FY 1983. Thus, FY 1990 marks the seventh full year of our using contractors for both financial and performance audits. Five audit support contractors provided over 40 percent of the total audit resources available to the OIG during FY 1989. During FY 1990 and FY 1991, it is expected that a substantial portion of the audit resources will again be derived from such contractors. These contractors will perform the full range of audit services.

Although the use of contractors enables the Office to provide more comprehensive audit services, there is a downside. A substantial commitment of in-house resources is necessary to prepare for and maintain effective use of these external resources.

The use of contractor personnel also creates certain organizational challenges. For example, reliance on contractors, at times, precludes the OIG from developing the in-depth institutional knowledge that is gained when OIG employees perform the work. Additionally, the use of audit support contractors presents special concerns in the area of organizational independence. By statute, the OIG must remain independent of Departmental operations and activities to ensure objectivity both in fact and in appearance. An audit support contractor may, and sometimes does,

perform contractual services for other Departmental elements, which could impact on the independence of the OIG. We have taken steps to identify and prevent any such impairment. For example, before issuing a task order, contractors must provide a written statement certifying that the contractor does not have impediments that could result in biased reporting, or an appearance of biased reporting. My office provides strict oversight of all the contractor's work products, and the contractors are bound to government auditing standards. However, because of potential appearances of, or actual organizational conflicts, we must limit the use of our contractor auditors. Thus, with contractor auditors, we lack the flexibility available to us when we use federal auditors.

The OIG also makes extensive use of the Defense Contract Audit Agency (DCAA) to audit DOE contracts in those areas where the DCAA has audit cognizance.

FUTURE OUTLOOK

The OIG will continue to focus its efforts on reviewing those critical areas associated with Presidential and Secretarial initiatives. These include cleanup of environmental damage at nuclear weapons facilities, cleanup and storage of radioactive and other waste, and other environmental, safety and health issues. Other important concerns include Safeguards and Security, the Weapons Programs, the Superconducting Super Collider, energy efficiency, and management issues that impact the economy,

efficiency and integrity of operations. We will also continue to review the Department's management of major systems acquisition and work-for-others program. Greater emphasis will be placed on developing investigations associated with contract/procurement fraud, and the environment, safety, health and the integrity of both Departmental and contractor employees. The OIG will pursue these and other major initiatives outlined in the Secretary's ten-point plan and the Administration's list of "High Risk" programs.

The Office of Audits is currently reviewing the DOE's overall implementation of the major systems acquisition program. Some specific reviews include: costs of the Yucca Mountain Project; contingency planning concerning the Waste Isolation Pilot Project; and procurement practices at Bettis Atomic Power Laboratory.

In the area of environment, safety and health, Audits is conducting reviews of: testing laboratory support to environmental sampling and analysis program; Environment, Safety and Health management information systems; budgeting for environmental activities; and training of employees in requirements of the Resource Conservation and Recovery Act.

Furthermore, the Office of Investigations will use its additional FTEs, in part, to investigate allegations or evidence of criminal or civil violations involving environment, safety and health issues. In addition, our toll-free hotline remains a ready channel for individuals to report suspected environment, safety and health violations or other crimes.

A number of ongoing inspections are related to issues of environment, safety and health. Some examples are: asbestos and mercury issues at a national laboratory; allegations that data was fabricated and included in an environmental survey; alleged radioactive contamination at a DOE facility; the air quality of a DOE building; construction quality assurance at a DOE project; product substitution; reporting issues regarding a water hammer at the K Reactor in Savannah River; the drug program at Lawrence Livermore National Laboratory; and, alleged irregularities with an accident investigation.

Inspections and Analysis is also involved in issues regarding the protection of contractor employees from reprisal for whistleblowing. Specifically, two inspections pertain to complaints of reprisal made by contractor or subcontractor employees. Another area of concern is operator incident reporting and a review is underway. Reviews are also ongoing with respect to Management and Operating contractor organizational conflicts of interest, contractor executive salaries at a major facility, classified document control at a major facility, a work-for-others project at Oak Ridge National Laboratory, and a classified work-for-others project conducted through the Albuquerque Operations Office. The Office of Audits is also reviewing reimbursable work at Oak Ridge.

As I reported to you last year, the cyclical audit plan for the Department's integrated contractors is being continued. This plan, which originally began in FY 1988, prescribed that every significant function of

a contractor's operations should be audited at least once every five years. Under this plan, a number of integrated contractors with identical functions will be reviewed during the same time period. The integrated contractor audits, which are generally more in depth than prior financial audits provide documentary support when signing the required annual statement of operations. The progress on these audits has been slower than originally anticipated. We have found that the audit cycle is in fact 10 to 12 years rather than the 5 years originally prescribed. In addition, we are finding that our OIG resource levels require us to rely on the integrated contractors' internal auditors. The Office of Audits is currently studying this reliance. The immediate impact is that most opinions on the required annual financial statement of operations will be qualified opinions due to our inability to complete the normal steps that are part of standard financial and compliance auditing.

We are also conducting audits of the Department's defense nuclear production capabilities including reviews of: the Field Materials Production Center at Fernald; the Naval Fuels Facility at Savannah River; and the Reactive Metals Inc. extrusion facility.

Investigative caseload continues to shift toward investigating criminal and serious administrative violations among the DOE's programs and operations. The makeup of the investigative case workload includes contract procurement fraud, environmental violations, the integrity of Departmental and contracting officials, and issues related to the operation

of the DOE's programs. Some of these issues involve complex investigations addressing the relationship between the Department and its contractors, and have resulted in recommendations to the DOE management regarding the integrity of this process.

A general management inspection of the San Francisco Operations Office (SAN) was initiated at the end of FY 1989. The results of this inspection are expected in the near future. Special emphasis was given to administration of SAN's Management and Operating contracts. The inspection addressed a wide range of subject areas including: environment, safety and health; defense programs; research and development; oversight of contractors; industrial relations; personnel practices; and, procurement practices. The broad scope of the inspection required assignment of all Inspections and Analysis resources as well as augmentation by other OIG and Departmental elements.

With the additional staff in FY 1991, Inspections and Analysis expects to conduct four general management inspections and continue other reviews to identify deficiencies which, when corrected, will enhance the efficiency and effectiveness of the DOE programs, thereby ensuring that Federal funds are being spent in a productive manner and for the purpose intended. Also, Inspections and Analysis will continue to conduct special inquiries in response to congressional concerns, management requests, and allegations from the public involving non-criminal matters.

In order to track the progress made in meeting organizational goals and objectives, we are continuing to implement a single, consolidated Database Management System. Implementation is approximately 60 percent complete. This System integrates the tracking, reporting and results of audit, investigation and inspection efforts. It will also track training, personnel, budget, project and travel management, timekeeping, and equipment and software inventory functions.

ACCOMPLISHMENTS

In FY 1989, environment, safety, and health issues were a major focus and concern for the Department. On three occasions, I appeared before Congressional Committees to testify on the DOE involvement in this area. The OIG and the Office of the Assistant Secretary for Environment, Safety and Health jointly established an interim Environmental Hotline that is being operated by the OIG. We also recommended to the Secretary that the Department take action to implement a system, assuring that contractor employee complaints of reprisal for making health and safety complaints are fairly and adequately adjudicated. The Department has drafted a notice of proposed rulemaking designed to address such contractor employee reprisal complaints.

In FY 1989, the OIG issued 348 audit reports, 256 of which were internal audit reports. These reports contained recommendations which, when implemented, would enable the Department to use an estimated $615.9 million

more efficiently. In support of procurement activities, the OIG also issued 92 audit reports involving Departmental contractors and grants. These reports identified a total of $8.8 million in questioned costs and $12.2 million in unsupported costs. Thus, the total impact of audit reports for FY 1989 was $636.9 million. Last year at this time I reported a total impact of $363.4 million to you. This is an increase of some 75 percent over the previous year.

During the first 2 months of FY 1990, the OIG has issued 58 audit reports, 48 of which were internal. Recommendations made in the 48 internal audit reports issued would enable the Department to use an estimated $126 million more efficiently.

Our Audit Office, in coordination with the FBI, developed a training course on the auditor's responsibilities in detecting illegal acts. This course incorporates the new professional auditing standards for designing audit steps which may identify illegal acts. The course has been well received and has been given to numerous audiences including many of the newly created Inspector General Offices.

In FY 1989, 72 investigative cases were referred to prosecutive authorities and 25 were accepted for prosecution. As a result, 11 individuals were indicted and 13 were convicted. Ninety-six administrative matters were referred to management for review and 19 referrals were made to management for corrective action. Thirty-three disciplinary actions were taken.

Sixteen additional investigative cases were referred for prosecution during the first 4 months of FY 1990. This is more than twice the number reported for the same period last year. Thirty-six matters were referred to Departmental managers for administrative action as opposed to 17 during this same period last year. The number of referrals sent to management for review and/or corrective action, and the number of indictments and convictions continues to exceed those of past years. Monetary collections resulting from investigative efforts have greatly increased, from $150,210 reported in FY 1986, to $616,797 in FY 1989, to $1.6 million already reported in the first 4 months of FY 1990.

As mentioned earlier, the Office of Inspections and Analysis devoted significant resources to the inspection of the San Francisco Operations Office. In addition to that major effort, Inspections and Analysis produced 12 additional inspection reports in FY 1989. These reports summarized reviews pertaining to Management and Operating Contractor accountability, environment, safety and health, and national defense needs. Our inspection report on contract clauses that indemnify Management and Operating contractors, issued in September 1989, addressed the subject of contractor accountability. This report has received considerable attention. We testified regarding this report at hearings both before the Senate and the House. Following our report, the Department issued a notice of proposed rulemaking to increase accountability for profit-making Management and Operating contractors.

Our Inspections and Analysis Office took the lead in gathering and compiling investigative data from 18 OIGs in order to describe the characteristics of the OIG investigations. This newly developed statistical information may assist investigations managers in developing strategic plans for their offices and the general allocation of resources. The final product was reported by the President's Council on Integrity and Efficiency's Committee on Integrity/Law Enforcement in July 1989.

The OIG has taken an active role in assisting the Department in meeting the requirements of the Federal Managers' Financial Integrity Act. The Inspector General is a member of the Department of Energy's Internal Control and Audit Review Council. We also continue to work closely on cooperative efforts with the President's Council on Integrity and Efficiency.

Our Office's Semiannual Report covering activities for the first half of FY 1990 will be submitted to you in May 1990.

FUNDING LEVEL

The following is a description of the FY 1990 appropriation and the FY 1991 request:

	FY 1990 Funding Level	FY 1991 Budget Request
Salaries/Other Compensation	$11,459,000	$12,416,000
Benefits	2,280,000	2,552,000
Travel	1,300,000	1,433,000
Services	10,899,000	12,020,000
Contract Auditors (Including DCAA)	(8,869,000)	(8,976,000)
Other Contractual Services	(2,030,000)	(3,044,000)
Capital Equipment	-0-	-0-
	$25,938,000	$28,421,000

In FY 1990, we have a total of 240 authorized FTEs. In FY 1991, our request is for 256 FTEs. The 16 additional FTEs will be assigned to the Office of Inspections and Analysis. This increase will allow the OIG to proceed with carrying out its mission in critical areas associated with Secretarial initiatives including Environment, Safety, and Health; Safeguards and Security; intelligence; and management issues that impact on the economy, efficiency and integrity of operations. An increase in resources will also permit the OIG to increase its reviews of major DOE programs, projects, and systems, including DOE Operations Offices.

The OIG continues to make steady progress in fulfilling its mandate to detect and prevent fraud and abuse and to promote efficiency and economy in the Department of Energy's programs and operations.

I appreciate the opportunity to appear today before this Subcommittee and would be pleased to respond to any questions you may have.

U.S. Department of Energy
Office of the Secretary
Washington, D.C. 20585
202/586-5534

BIOGRAPHY

MELVA GIBSON WRAY

Melva Gibson Wray was nominated by President Bush on August 24, 1989 to be Director of the Office of Minority Economic Impact, U.S. Department of Energy (DOE), and confirmed by the U.S. Senate on November 9, 1989.

In this position, which is equivalent to an Assistant Secretary position, Ms. Wray is responsible for advising the Secretary on the effects of energy policies, programs, legislation and regulation on minorities, minority communities and minority business enterprises. She also advises the Secretary on specific methods whereby minority participation in the Department's programs can be significantly improved.

Ms. Wray's other duties include the development of socioeconomic research programs for energy impact assessments; recommending to the Secretary specific programs and policies to assist minorities and minority communities; providing management and technical assistance to minority educational institutions and minority business enterprises; providing financial assistance to minority entrepreneurs; and coordinating relevant programs within the Department and among other Federal, State and private energy industry organizations.

In December 1989, Ms. Wray was appointed by the White House Initiative on Historically Black Colleges and Universities (HBCU) as a member of the White House Initiative Task Force for Economic and Business Development. In this capacity, she joins senior representatives from other Federal agencies, the private sector and HBCUs on a National task force charged to: 1) explore ways to increase the participation of HBCUs in business and economic development activities; 2) encourage partnership arrangements between HBCUs and minority businesses; and 3) assist in establishing viable business enterprises located at, and operated by, HBCUs. Ms. Wray will be instrumental in establishing a technical networking base for economic and business development activities which will enhance minority entrepreneurial activities in the energy industry.

Before Ms. Wray's confirmation as Director, she served as a consultant to the Secretary. In this capacity, she assessed various issues relating to current energy programs, with the objective of developing specific strategies to increase the level of participation of minorities and minority communities in Departmental programs and in the energy industry.

Prior to her government consultancy, Ms. Wray served as an Account Executive at General Electric Consulting Services (GECS) in New York City. She developed and implemented operational strategies to enhance the technical assistance approaches of GECS consultants on long-term assignments

(more)

with large corporations such as International Business Machines (IBM), Mobil Oil Company and the Metropolitan Life Insurance Company.

From 1981 to 1989, Ms. Wray held a number of marketing and technical managerial positions in various divisions of IBM in Boston, New York and Washington, D.C. In these positions, she established an illustrious career in systems engineer-ing, management and organizational procedures, internal controls, long-term planning, program evaluation, and operational and developmental strategies. She interfaced with numerous national and international corporate clients in matters relating to the application of changing technologies relevant to their industries. Ms. Wray also functioned as liaison between IBM and the White House Executive staff, identifying their short and long-term resource needs, and implementing automated systems to enhance their overall levels of productivity. From 1980 to 1981, Ms. Wray served as an Economist at the U.S. Department of Labor, Bureau of Labor Statistics.

Ms. Wray received her B.A. degree in Economics from Spelman College in Atlanta, Georgia in 1980. She was the recipient of IBM's Regional Director's Marketing Award for Outstanding Achievement in 1984. In 1985, she received IBM's Divisional President's Award for Outstanding Managerial Performance. She was also honored in 1989 at General Electric Consulting Services for "Attaining her Yearly Quota in Five Months."

Ms. Wray is active in a number of community organizations and currently resides in Alexandria, Virginia.

January 1990

Statement of Melva Gibson Wray
Director, Office of Minority Economic Impact
Department of Energy
FY 1991 Appropriations Hearing

Mr. Chairman and Members of the Subcommittee:

I appreciate this opportunity to appear before you today to discuss the FY 1991 Congressional budget request for the Office of Minority Economic Impact (MI). The programs which I will discuss for MI include (1) Socio-economic Research and Analysis, (2) Management and Technical Assistance and, (3) Financial Assistance programs.

Mr. Chairman, before I present an overview of MI's FY 1991 budget, I would first like to take this opportunity to highlight a few significant accomplishments which have been achieved during the past four months of my tenure in MI. I think it is important for me to mention these few attainments because, excellent programs which had been developed to provide technical assistance to minorities and enhance the Department's energy assessment capabilities were basically put on hold, prior to my involvement with MI.

- The Office currently represents the Department on two Federal Agency Task Forces initiated by the Executive Director of the White House Initiative on Historically Black Colleges and Universities. These are: (1) The Task Force on Science and Technology and, (2) The Task Force on Economic and Business and Development.

- The Cooperative Developmental Energy Program at Fort Valley State College, in the State of Georgia, enhanced its energy curriculum by forming consortiums with two major universities that will offer dual degree programs in electrical engineering and mechanical engineering.
- In a joint project with the Office of Energy Research, MI added a "Minority Education Menu" to the Department's University On-Line Information Service to allow quick access to any DOE educational activity targeted to minorities.
- In cooperation with the National Aeronautics and Space Administration, MI now supports a program of enhanced minority science and technology training and research to increase the pool of minority professionals for the aerospace and energy industries.
- A unique analytical framework of demand system models and data bases, developed by the Socio-economic Research Program, is currently being used for different segments of the National Energy Strategy initiative for residential and transportation indicators and for projections. In addition, a derivative of one of the models is being utilized for the Department's "Greenhouse Gas Emissions Study for Light Duty Motor Vehicles."
- MI is in the final planning stages for a joint workshop with Argonne National Laboratory in May 1990, to focus

on "Minority Educational Opportunities in Energy Assessments." This new initiative will provide a unique focus to the Department's educational initiative by incorporating research methodologies, which are relevant to energy analysis and policy, into joint educational programs at the national energy laboratories.

OVERVIEW

The goals and objectives of MI are to assist in determining specific energy policies, programs, legislation, and regulations which are needed to significantly enhance the economic conditions of minorities in the dynamic energy technology environment. In this way, focused management and technical assistance programs are developed and implemented to assist in increasing the level of minority participation in the programs of the Department and the energy industry.

The program goals and objectives support the activities which have been mandated by the authorizing legislation for MI, as specified in Section 211 of the Department of Energy's Organization Act (42 U.S.C. 7141). In its efforts to mitigate potential adverse impacts of energy policies on minorities, the specific program focus of MI is as follows:

- A Socio-economic Research and Analysis Program develops analytical tools to assist the Department, other Federal and State agencies, and the energy industry to

determine the effects of the Department's programs, policies, legislation, and regulations on minorities.

- Management and Technical Assistance is provided to minority educational institutions and minority business enterprises through assistance programs, such as infrastructure development, collaborative research, and private and public partnerships. In addition, MI coordinates the Department's implementation of Executive Order 12320, the Historically Black Colleges and Universities Initiative.
- Financial Assistance is provided to minority business enterprises by enhancing the level of operating capital in minority financial institutions (through purchases of certificates of deposit) to enable them to assist minority businesses and minority communities.

FY 1991 BUDGET HIGHLIGHTS

Socio-economic Research:

- In coordination with the Energy Information Agency, the methodology of the unique socioeconomic data base and the capabilities of the analytical tools developed by MI will be updated to provide energy program assessments and identify relevant policy implications. Software developed to facilitate micro-computer versions of analytical segments of the database, will

be made available for use by other agencies, energy industry analysts and minorities, to enhance their energy assessment capabilities.

- Joints projects will be established with national energy laboratories, intra-departmental programs, and other Federal agencies to enhance the Department's National Energy Strategy objectives through the implementation of technical research, educational programs, residential energy conservation programs, and relevant business enterprise developmental strategies.

Management and Technical Assistance:

- The Minority Honors Training and Industrial Assistance Program will continue to provide scholarships to approximately three hundred and fifty financially needy minority honor students for energy and technology-related training at two-year post secondary institutions, to increase the technical labor base in industry sectors. The program will also be enhanced to expand the number and characteristics of the linkages among the schools and the industrial partners to include, on a limited basis, DOE's operating contractors and national energy laboratories.
- The Minority Educational Institutions Assistance Program will continue to provide cost-sharing for start-up operations of science and technology research and development centers. Assistance will be provided

to principal investigators at minority educational institutions to increase faculty participation in research and development efforts. Continued support will be provided for training minority undergraduates in energy-related careers.

- The National Minority Energy Information Clearinghouse will continue to develop and update the minority economic impact bibliographic data base. Focus will be on addressing the informational needs of its diverse users. The information gathering and dissemination approach will also be restructured to maintain continuity with MI's multifaceted programs. The Minority Energy Information Clearinghouse Bulletin Board System will be kept current with relevant information on MI's programs.
- The Minority Business and Community Development Program will utilize MI's prototype educational and business development training program for minority entrepreneurs in a number of large urban areas and in smaller regions where there is a high concentration of minorities, such as American Indians and Hispanics, who could benefit significantly from the implementation of this type of program. Efforts will also be made to establish linkages with public and private sources of funding and with technical expertise at minority financial institutions.

Financial Assistance:

- The Bank Deposit Financial Assistance Program will continue to assist minority banks and savings and loan institutions to increase the level of their operating capital. Strategies will be developed to increase the number of Administrative Financial Institutions (AFIs) and Minority Financial Institutions (MFIs) participating in the program. This will increase the number of Certificates of Deposit purchased in each MFI and significantly increase the utilization of the 250 million dollars currently available for the program.
- Plans are being developed to propose a restructuring of the Business Loan Program to incorporate relevant provisions which will increase the effectiveness of the program to the minority business community.

The budget request for the Office of Minority Economic Impact for FY 1991 is $3,448,000. The following table provides a more detailed overview:

Budget Authority

(Dollars in Thousands)

	FY 1991
Research Program	$ 819
Management and Technical Assistance Program	$2,013
Financial Assistance Program[1]	$ 0
Program Direction	$ 616
	$3,448

1 The Bank Deposit Financial Assistance Program is funded from the Petroleum Escrow Fund.

FY 1990 ACTIVITIES

In FY 1990 the Office of Minority Economic Impact is involved with numerous Secretarial initiatives in addition to continuing its focused programs in the three major areas. We have targeted some program strategies in following areas, for the remainder of this fiscal year:

Socio-economic Research:

- Completion of testing of energy impact assessment tools for PC software packages. This will be available through the National Energy Software Center.
- Completion of Cost-reduction data analysis and retrieval tabulation system for users of massive data files. This will be available through the National Technical Information Service.
- A joint workshop will be held with Argonne National Laboratory in May 1990 to structure a specific "action plan" for developing and implementing feasible research and education program opportunities in energy assessments.

Management and Technical Assistance Program

Minority Honors Training and Industrial Assistance Program:

- Support to the eight schools currently in the program will be continued, with plans to

expand to include new program areas. Emphasis is being placed on transfers of graduates to four-year institutions for continued development at the undergraduate levels.

Minority Educational Institution Assistance Program:

- Funding for projects to develop research centers at minority educational institutions will continue.
- The activities of the education programs will be expanded to focus on minority undergraduate training for energy-related careers and a math/science leadership development and recognition program, with emphasis on precollege students.
- MI will provide technical assistance to minority educational institutions in developing formal and informal alliances with industry, government and research laboratories. Among these new alliances formed is a consortium of minority institutions for environmental restoration and waste management.

Minority Energy Information Clearinghouse

- The Minority Energy Information Clearinghouse

Bulletin Board System was developed and implemented to provide information on MI's programs, and other programs in the Department that impact minority population groups.

- o Additional educational programs were added to the Education Institutions Tracking System which became operational in FY 1989.

Minority Economic Business Development Program:

- o The prototype educational and business development training program will focus on select business opportunities in energy-related fields and establish industrial linkages in developing the program.

Minority Financial Institution Deposit Program:

- o MI will have developed strategies to structure a more efficient and effective program to encourage additional participation of eligible Administrative Financial Institutions and Minority Financial Institutions, to improve the regional representation of eligible financial institutions.

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Business Loan Program:

- Plans are being developed to propose a restructuring of the program to increase the effectiveness of the program to the minority business community so that minorities can participate fully in research, development, and contract activities of the Department.

Mr. Chairman, and Members of the Subcommittee, it has been a great privilege to appear before you today and I look forward to my continued service to the Department of Energy and the Administration.

U.S. Department of Energy
Office of the Secretary
Washington, D.C. 20585
202/586-5534

BIOGRAPHY

STEPHEN A. WAKEFIELD

Stephen A. Wakefield was nominated by President Bush to serve as the General Counsel of the U.S. Department of Energy (DOE), and confirmed by the Senate on October 5, 1989.

Previous to this appointment, Mr. Wakefield was a Senior Partner in the Texas law firm of Baker & Botts, and Chairman of the firm's energy practice in Houston and Washington. He has been with the firm since 1965, except for a prior period of governmental service from 1970 to 1974, and employment as a corporate executive during 1985 and 1986. Mr. Wakefield has been a partner with the firm since 1974.

Mr. Wakefield's departure from Baker & Botts in 1985 was to serve as Vice Chairman and General Counsel of United Energy Resources, Inc., (UER), which at the time was a diversified energy company headquartered in Houston. He also served during this period as President of UER's major interstate pipeline subsidiary, United Gas Pipe Line Company.

In 1970, Mr. Wakefield had left the firm to accept the position of Assistant to the General Counsel of the Federal Power Commission, a predecessor to the Federal Energy Regulatory Commission. He later served as Deputy Assistant Secretary of the U.S. Department of the Interior. In 1973, President Nixon appointed Mr. Wakefield as Assistant Secretary of the Interior for Energy and Minerals.

Mr. Wakefield also assisted in the creation of the Federal Energy Office, a predecessor to DOE, during the Arab oil embargo in late 1973, where he was appointed Assistant Administrator for International Affairs. He served concurrently in that position until his return to Baker & Botts in May 1974.

Born in Olney, Illinois, Mr. Wakefield was raised in Fort Worth, Texas, attended the University of Texas at Austin, and was graduated with honors from the Texas School of Law in 1965. He was a member of Chancellors and an editor of the Texas Law Review.

Mr. Wakefield is married to the former Patricia McGuire of Dallas, Texas. They have six children.

October 1989

STATEMENT OF
STEPHEN A. WAKEFIELD
GENERAL COUNSEL
DEPARTMENT OF ENERGY

Mr. Chairman and members of the subcommittee, I am pleased to appear before you to discuss the fiscal year 1991 budget request for the Office of General Counsel.

The Office of General Counsel provides legal services for the Secretary of Energy and the Department, with the exception of the Federal Energy Regulatory Commission. These services include legal counseling, legislative drafting, development of regulations, and the conduct of litigation. In addition, the office administers the Department's standards of conduct and patent programs. As of March 1, 1990, the office totalled 163 individuals, of which 115 filled attorney positions.

During the past year, our attorneys, in conjunction with Department of Justice attorneys, have represented the Government in a wide array of significant lawsuits involving, among others, environmental, contractual and waste storage issues.

In the area of regulatory development, the Office of General Counsel has played a significant role in two recent and still ongoing rulemaking proceedings. One is a Proposed Rulemaking to amend the Department's contractual arrangements to increase the accountability of its management and operating (M&O) contractors

and to redefine the relationship between DOE and those contractors. The other is a Notice of Inquiry and Request for Public Comments on the Department's plans to implement its new authority to impose civil penalties under the Price-Anderson Amendments Act.

Although this office's litigation and rulemaking efforts are certainly the most visible means by which we provide legal support to the Department, other legal services may have an equal impact over the long term. For example, the office is actively engaged in the development and consideration of legislative issues that would affect the Department. Other services this office provides include support for the Clean Coal Technology program, international arrangements, such as the U.S.-Canadian Free-Trade Agreement, alternate financing for the Strategic Petroleum Reserves, and the considerable and still growing effort to assure that the Department's activities comply with the letter and the spirit of laws and regulations designed to protect the environment and public and worker health and safety.

The FY 1991 budget request for the Office of General Counsel is $10,959,000. This request will provide $9.6 million for 159 FTEs and $1.3 million for support funding. Three FTEs within the Office of General Counsel will be billed to the Nuclear Waste Fund. With this budget, I believe the office can continue to provide the same professionalism in rendering legal services which this office has furnished to the Department since its formation.

U.S. Department of Energy
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Washington, D.C. 20585
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BIOGRAPHY

JOHN J. EASTON, JR.

John J. Easton, Jr. was nominated by the President on June 22, 1989 to be Assistant Secretary for International Affairs and Energy Emergencies, U.S. Department of Energy (DOE), and confirmed by the Senate on October 5, 1989. In this position, he serves as the principal international policy advisor to the Secretary and spokesman for the Secretary on matters of international importance. He also coordinates DOE's non-nuclear emergency preparedness planning and emergency operations.

In addition, Mr. Easton is responsible for maintaining DOE's relationship with foreign governments and international energy organizations, the development of departmental positions for international negotiations, and the implementation of international cooperative agreements.

Prior to joining the Department of Energy, from 1987 to 1989, Mr. Easton was in private law practice with the Burlington, Vermont law firm of Miller, Eggleston and Rosenberg, Ltd. Before that, he was Vice President of Syn-Cronamics, Inc., a New Jersey based international consulting firm.

Mr. Easton was twice elected Attorney General of Vermont and served in that position from 1981 to 1985. In 1984, he was the Republican candidate for Governor.

Prior to his selection as Attorney General, Mr. Easton served for two years as Director of the Division of Rate Setting for the Agency of Human Services. From 1975 to 1978, Mr. Easton was Assistant Attorney General and Chief of Consumer Protection. For five years previous to this position, he was in private law practice in Stowe and Montpelier, Vermont.

Mr. Easton was educated in elementary schools in Virginia, Georgia and French Morocco, and high schools in Nebraska and California. He attended the University of Colorado (B.S., Accounting, 1964), and Georgetown University Law Center (J.D., 1970). Mr. Easton served in the U.S. Air Force from 1964-68, resigning with the rank of Captain.

Mr. Easton has held a variety of leadership positions in the American Bar Association and the Vermont Bar Association. He also served on the boards of several Vermont organizations prior to joining DOE.

Mr. Easton is currently living in Arlington, Virginia.

October 1989

Statement of John J. Easton, Jr.

Assistant Secretary

for International Affairs and Energy Emergencies

Department of Energy

FY 1991 Appropriations Hearings

Mr. Chairman, Members of the Subcommittee:

I am pleased to testify before this Subcommittee on the FY 1991 budget request for the Office of International Affairs and Energy Emergencies. I shall be discussing those portions of our request that support the Office of International Affairs and the Office of Policy and Management, which includes my immediate office and my Management Services administrative support staff.

PROGRAM AUTHORIZATION GOALS

The Department of Energy Organization Act of 1977 (Pub. L. No. 95-91) establishes the overall policy role for the Office of International Affairs. This Act requires the Department to develop and implement international energy policy consistent with domestic energy and U.S. foreign policy and to provide independent technical advice to the President on international energy-related

matters. This general mandate is based upon the importance of international influences on the domestic energy program and the importance of energy as a component of foreign policy. My office discharges this mandate in close cooperation with other offices of the Department, as well as the Departments of State, Defense, Commerce, and the Treasury and other concerned agencies such as the Nuclear Regulatory Commission, the Environmental Protection Agency and the U.S. Trade Representative.

My Office also carries out specific international responsibilities and commitments established by other legislation. Based on these authorizations, I assist the Secretary of Energy in: promoting international trade in energy commodities and support services; monitoring, analyzing, and assessing world energy markets, trade, price and supply trends, and technological developments; maintaining relationships with foreign governments and energy organizations; supporting international energy organizations; developing Departmental positions for international negotiations; developing, negotiating, implementing and assessing U.S. international nuclear policies, including nonproliferation policies; developing, negotiating and administering a program of technical exchanges and collaborative research and development programs with foreign governments (which represent important U.S.

Government commitments, including support of broader political and economic objectives); and promoting U.S. energy/environmental policies in international meetings and negotiations.

INTERNATIONAL AFFAIRS PROGRAM ORGANIZATION

Three organizations reporting to the Deputy Assistant Secretary for International Affairs carry out the work of the International Affairs program . The organizations and their responsibilities are as follows:

Office of Nuclear Nonproliferation Policy

The Office of Nuclear Nonproliferation Policy has a major role in implementing U.S. nuclear nonproliferation policy, including: promoting the work of the International Atomic Energy Agency (IAEA); support to the Department of State in negotiating new international agreements for cooperation in the peaceful uses of nuclear energy; and reviewing and approving "subsequent arrangements" under the Nuclear Nonproliferation Act and the Atomic Energy Act. The IAEA and other international organizations have undertaken major new international nuclear safety initiatives. We will continue to strengthen the IAEA nuclear

safety and nuclear safeguards activities to ensure the safe operation of nuclear power plants worldwide and to prevent the diversion of nuclear materials.

Each year the Office analyzes and processes over one hundred "subsequent arrangements" for the reprocessing or transfer of plutonium, or the international sale or transfer of nuclear materials. In this effort, the Office has the lead among other Executive Departments in establishing policy decisions. These sensitive cases involve complex analyses and requirements for Congressional review.

Office of International Research and Development Policy

The Office of International R&D Policy coordinates the development of nuclear and non-nuclear R&D cooperation with foreign governments, both bilaterally and through multilateral organizations. In this role, the Office: (1) coordinates with DOE programs and staff, the Department of State, and other U.S. agencies on international science, technology and R&D matters; (2) recommends policies and approaches for cooperation with specific countries or international organizations in these areas; and (3) completes agreements for cooperation with these countries or organizations.

The Office manages all aspects of the Department's participation in the Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development (OECD) and the Committee for Research and Development (CRD) of the International Energy Agency (IEA).

The Office also has primary responsibility within the Department of Energy for prescribing policy and procedures for: visits and long-term assignments by foreign nationals to DOE Headquarters, laboratories, field offices and other facilities; and all foreign travel by DOE employees and DOE-funded contractor personnel.

Office of International Energy Analysis

The Office coordinates the Department's energy export activities, in collaboration with DOE program offices. Promotional opportunities are designed for energy commodities, energy technologies, and associated energy service industries, such as coal, clean coal technology, and oil and gas equipment. The Office identifies barriers to trade and negotiates removal of impediments in bilateral and multilateral meetings.

The Office monitors and manages technical exchanges with key producing and consuming countries and provides substantive and protocol support for visits by foreign energy officials to DOE or visits by DOE officials to their counterparts overseas.

The Office also manages the international aspects of DOE/U.S. participation in energy security programs by developing strategies for encouraging organizations and countries to adopt policies and programs that complement U.S. international energy security policy. This policy is directed toward primary reliance on market forces, balanced and mixed energy resources, greater strategic oil and gas stock buildup, and coordination of plans among IEA members for early oil stock drawdown in the event of a major oil supply disruption.

FY 1989 ACCOMPLISHMENTS

The following are among the major accomplishments of the Office of International Affairs during FY 1989:

- Under the Deputy Secretary's direction, expanded the Department's efforts for energy exports through a new initiative to include associated energy service industries

and additional energy technologies involving more direct industry participation.

- Coordinated the Department's contribution to the President's initiatives for Poland and Hungary involving clean coal technology and nuclear safety techniques.

- Continued discussions with potential international partners in the Superconducting Super Collider program aimed eventually at obtaining the maximum foreign participation in this major scientific facility.

- Developed a new Nuclear Safety Memorandum of Cooperation with the USSR, involving the Nuclear Regulatory Commission, and arranged for extension of the Agreement for Cooperation in the Peaceful Uses of Atomic Energy.

- Prepared major analyses for the transfer of irradiated power reactor fuel from Switzerland to EURATOM for reprocessing.

- Coordinated DOE support for the IAEA, including recruitment of U.S. nationals into IAEA positions.

- Administered arrangements for technical operations directed toward improvement in the effectiveness of U.S. support of the IAEA (the State Department funds these arrangements at an annual level on the order of $6 million.) Coordinated with ACDA to direct the RERTR Program at Argonne National Laboratory ($1.56 million dollars transferred to DOE).

- Conducted bilateral energy discussions with Mexico, Venezuela, Canada, Japan, Korea, Saudi Arabia, United Arab Emirates, Qatar and Norway, which have led to increased energy trade and to improvements in the security of energy supply.

- Provided an analytical base for policy decisions by closely following the international energy supply policies of major oil producing and consuming governments and international oil markets, including spot markets, pricing trends, patterns of sale, and movements of crude oil.

- Led the U.S. Government's formal consultations with Canada on the natural gas trade.

FY 1990-1993 OBJECTIVES

The continued success of our international energy policy initiatives will be highly dependent upon our ability to fulfill some well-defined objectives for the coming years. These objectives are:

1) coordinate the Secretary's initiatives on safe operation of nuclear reactors and cooperation in the fields of radioactive and hazardous waste mangement in the Soviet Union; 2) continue to support DOE's international R&D efforts by developing, coordinating, and completing agreements for cooperation, and improving management of the international R&D agreement process; 3) implement the international plan to obtain maximum foreign participation in the SSC program, and prepare and negotiate the appropriate international agreements; 4) coordinate inter-agency activities and the government/industry interface relative to the Department's cooperation with and assistance to Eastern Europe; 5) continue to support the quadripartite conceptual design studies related to the next generation of large devices in magentic fusion and high energy physics

research; coordinate development of foreign collaboration; 6) coordinate and monitor expanding international activity related to climate change and technologies and policies to help mitigate production of greenhouse gases; 7) implement new policies and management information systems for management and analysis of DOE funded foreign travel and of visits and assignments to DOE facilities by foreign nationals; 8) maintain and strengthen the Department's commitment to improvement of the international nuclear nonproliferation regime through programs designed to improve the effectiveness of the IAEA's safeguards and other programs; 9) provide technical assistance to the Department of State in efforts to conclude negotiations and enter into a new Agreement for Nuclear Cooperation with the European Atomic Energy Community (EURATOM); 10) continue intensive efforts to gain universal accession to the Nuclear Nonproliferation Treaty (NPT), including support to their NPT Review Conference; 11) manage of the Reduced Enrichment Research and Test Reactors (RERTR) program to achieve maximum foreign reactor conversions; 12) promote secure international energy trade by conducting analyses and developing policy initiatives in international coal, oil, natural gas, electricity, nuclear, conservation and

renewables; 13) expand the Department's activities in the Developing World, with increased cooperation from other agencies and departments; 14) in coordination with Department of Commerce and other federal agencies, provide international leadership to promote exports of energy commodities, energy technologies and associated support services; 15) promote the free market in bilateral and multilateral energy relations through, for example, the removal of trade barriers; 16) analyze political, economic and energy developments and trends in international markets in order to identify emerging issues which will affect U.S. international energy security interests; 17) promote enhanced cooperation and a more intensive energy policy dialogue to increase prospects for greater U.S. oil and gas technical services exports; 18) continue informal technical exchanges with key producing and consuming nations in order to promote understandings regarding our respective national energy policies.

Accomplishment of our objectives will help reduce the risk of nuclear weapons proliferation while expanding the worldwide peaceful and safe applications of nuclear energy; enhance U.S. international energy research and development

collaborative efforts; expand the international market for U.S. energy fuels and energy-related equipment, services and technology; provide a sound analytical basis on which to conduct our energy relations with both oil producing and consuming nations; establish and maintain a dialogue with other countries on important global energy and associated environmental matters; lessen U.S. vulnerability to energy supply disruptions, and provide accurate and reliable advice and support to the Secretary and other energy policy makers.

FY 1991 BUDGET REQUEST

International Affairs

Budget Summary

(Dollars In Thousands)

	FY 1990 Funding Level (estimate)	FY 1991 Request
International Policy Studies	$ 999	$1,359
Program Direction	$4,112	$3,700
Total IA Operating Expense	$5,111	$5,059

The FY 1991 budget request for International Affairs (IA) is $5,059,000, a decrease of $52,000 below our FY 1990 funding level. Our request for program direction funds is $3,700,000. At this level, 51 full-time equivalents (FTEs) are funded, the same as in FY 1990.

The FY 1991 budget request for International Policy Studies has two major components. The first component is our normal analytical and information systems work where we propose funding of $1,059,000, a modest $60,000 increase over the previous year.

This year, we include a new second item for the International Affairs budget, but an item that has been funded in previous DOE and Arms Control and Disarmament Agency budgets for more than a decade. We request $300,000 funding for the Reduced Enrichment Research and Test Reactors (RERTR) program. This request is a reduction from the $1.2 million funding in the Department's FY 1990 Nuclear Energy budget.

Our proposal captures the technology transfer, technical assistance, and training necessary to convert foreign research and test reactors to the low enriched uranium fuel previously

developed by the Department. The proposal does not include any funding for research and development of new fuels or further testing of existing fuels. An inter-agency review of this program concluded that further technical developments were not appropriate and that the entire RERTR program must focus on reactor conversions to gain the benefits of our previous work. Over the next five years, we believe that 37 reactors can be converted, leaving only 3 to 4 reactors operating on highly enriched uranium fuel.

Policy and Management

Budget Summary

(Dollars In Thousands)

	FY 1990 Funding Level (estimate)	FY 1991 Request
Total Policy and Management Operating Expense	$1,571	$1,000

The FY 1991 budget request for Policy and Management is $1,000,000, a decrease of $571,000 from our FY 1990 funding level. The decrease is due to a decline in part time staff. At this level, 12 full-time equivalents are funded. These funds include salaries and expenses for the immediate Office of the Assistant Secretary for International Affairs and Energy Emergencies and the Office of Management Services which performs administrative support functions for the organization. The funds requested are for salaries, benefits and travel as well as approximately $100,000 for contractual support.

This concludes my statement. I will be happy to answer any questions you may wish to ask.

Thank you.

U.S. Department of Energy
Office of the Secretary
Washington, D.C. 20585
202/586-5534

BIOGRAPHY

LINDA G. STUNTZ

Linda G. Stuntz is Deputy Under Secretary for Policy, Planning and Analysis, U.S. Department of Energy. In this capacity, she serves as advisor to the Secretary and Deputy Secretary in the formulation and review of national energy policy.

Before assuming this position on June 26, 1989, Ms. Stuntz served as a consultant to the Secretary of Energy. She left the Washington, D.C. law firm of Jones, Day, Reavis and Pogue in April 1989, where she had practiced energy regulatory and legislative law since 1987.

From 1986 to 1987, Ms. Stuntz was Minority Counsel and Staff Director to the Committee on Energy and Commerce of the U.S. House of Representatives. She was Associate Minority Counsel to the Subcommittee on Fossil and Synthetic Fuels of the Committee on Energy and Commerce, U.S. House of Representatives, from 1981 to 1986. Ms. Stuntz practiced law with Jones, Day, Reavis and Pogue from 1979 to 1981.

A native of Bellefontaine, Ohio, Ms. Stuntz received an A~~.~~B. in political science from Wittenberg University in 1976, and a J.D. degree from Harvard Law School in 1979. She is a member of the District of Columbia Bar and has practiced before several Federal appellate courts, including the United States Supreme Court.

Ms. Stuntz resides in Alexandria, Virginia, with her husband, Reid, and two children: Grace, 1, and Joe, 4.

June 1989

Statement of Linda G. Stuntz
Deputy Under Secretary
Office of Policy, Planning and Analysis
Department of Energy
FY 1991 Appropriations Hearing

Mr. Chairman, Members of the Subcommittee

I appreciate the opportunity to appear before you today to discuss the FY 1991 budget request for the Department of Energy's Office of Policy, Planning, and Analysis (PE). The budget request of $9.3 million will support the activities of an Office whose role and responsibilities have been substantially expanded by Secretary Watkins.

I would like to highlight this change in responsibility and its impact on the Policy Office staff and budget for FY 1991. The Policy Office, which in the past focused nearly its entire attention on policy analysis, now manages the Department's policy development process. This is consistent with Secretary Watkin's desire to assure close coordination of Departmental policy, programs and budget.

PE's most important current assignment is the development of the National Energy Strategy (NES). The NES, a Presidential initiative which will be completed in FY 1991, will provide the means to rationalize the Department's policy and program planning processes. We began this rationalization while developing the FY 1991 budget, drawing upon the results, thus far, of the public consultation process that has

characterized NES development. We will continue to refine the internal planning process in order to bring programs and budgets into line with the findings and recommendations of the NES. By FY 1992, the Department's budget will be closely aligned with the approved NES.

To maintain the relevance of the NES, the Secretary intends to update it periodically in response to changes in the marketplace, advances in technology, and domestic and international geopolitical and environmental developments. This will require on-going analysis and research as well as new tools and expertise.

To assure that NES recommendations are translated into action and that systems are in place to measure progress, the Secretary intends to establish within PE a capability to monitor NES implementation and to participate in the annual budget planning process. This capability will be developed incrementally over the current fiscal year and will be fully operational in FY 1991.

In order to support these new substantive responsibilities, PE staff and financial resources are being increased, albeit modestly, as is reflected in the staff levels and budget proposed for FY 1991.

A second new area of responsibility for PE is coordination of DOE's global climate change and associated environmental policy activities. These activities, which include analysis and research, policy development, and participation in international activities, are carried out by a variety

of DOE offices that heretofore operated without the benefit of cohesive senior management guidance and direction. Secretary Watkins has now established a DOE Steering Group for global climate change activities, co-chaired by the Deputy Under Secretary for PE and the Assistant Secretary for International Affairs and Energy Emergencies. These two Offices are now in a position to closely monitor the wide range of activities that are underway domestically and internationally and provide timely advice to the Secretary.

PE's environmental role was expanded further in February 1990, when the Department's environmental analysis program was transferred to this Office. The environmental program provides responsive analyses and options development with respect to significant issues that affect national energy supply, demand, and prices. In FY 1991, the program will emphasize the effects of potential global climate change, air quality, and waste issues on the energy industry. The environmental analysis program is providing major input to the development of a National Energy Strategy aimed at reconciling our country's need for energy with environment, safety and health requirements. The funding and associated FTEs for this program are not included in the Departmental Administration's appropriation, but are included in the Energy Supply Research and Development appropriation.

A third area of new responsibility for PE is alternative transportation fuels. PE coordinates DOE's implementation of the

Alternative Motor Fuels Act (AMFA) of 1988 and manages the activities of the Interagency Commission on Alternative Motor Fuels and the U.S. Council on Alternative Fuels -- two bodies created by the Act to assist in formulation of national policy in this important area. In addition, PE carries out studies required by the AMFA and provides support to the Environmental Protection Agency (EPA) in the design (and subsequent implementation) of the President's proposed Clean Fuels Program, one of the provisions contained in the Administration's legislation to amend the Clean Air Act.

Finally, PE is deeply involved in the development of Departmental policy for technology transfer. There are numerous technology transfer activities being pursued by DOE's program offices and National Laboratories. Until recently, however, these potentially very important activities were left to the discretion of departmental elements without the benefit of policy coordination. The Secretary believes that the results of the Department's research and development efforts, especially at the National Laboratories, should be placed at the service of the Nation as quickly as possible. In virtually every aspect of energy production and use, DOE has developed expert knowledge and technology that should be promptly transferred to energy producers and consumers. This effort will contribute to enhanced domestic industries, increased energy conservation, and improved environmental quality.

Mr. Chairman, the new responsibilities that have been delegated to PE extend our traditional role as policy analysts and advisors to the Secretary and Deputy Secretary of Energy. We are also engaged in a range of interagency and intergovernmental activities that have direct or indirect implications for energy policy.

In the past year, PE has been deeply involved in development of the President's Clean Air Act amendments, conducting state-of-the-art analyses of alternative fuels production and use, assessing least-cost utility planning activities around the Nation, and examining the role that energy plays in international trade. We have, furthermore, published the results of a rigorous analysis of U.S. conservation achievements, and have directed a number of important studies to be carried out by our National Laboratories in the areas of renewable energy potential, technology transfer, and global climate change. Finally, our staff provides technical support to U.S. representatives to the International Energy Agency (IEA) and to the Intergovernmental Panel on Climate Change.

OBJECTIVES

Specific objectives for FY 1991, formulated in response to Sections 102, 203, 657, and 801 of Public Law 95-91, of the Department of Energy Organization Act, are:

- completion of the NES and related supporting documentation, including legislative proposals, that will be submitted by the

President to Congress during the second quarter of FY 1991;

- development and implementation of a planning and program review system that fully integrates the objectives of the NES into the Department's annual and long-range planning and budgeting cycle;
- analyses of energy, environmental and technology transfer policy issues; and
- implementation of the Alternative Motor Fuels Act of 1988, including management of the studies and policy development activities of the Interagency Commission on Alternative Motor Fuels and U.S. Council on Alternative Fuels.

FY 1990 ACCOMPLISHMENTS

NATIONAL ENERGY STRATEGY ISSUES

In July 1989, the Department of Energy embarked on the development process for the NES. The Department just completed a seven month public hearing process. A compilation of hearing and submitted testimony thus far received will be published as an Interim Report in April 1990. We will continue the NES development process through the end of the calendar year and propose recommendations to the President in December 1990 in the first edition of the National Energy Strategy. The NES process includes:

NES Public Hearings (August 1989 - February 1990)

The first round of five hearings was held in five cities throughout the country during the August and September of 1989.

The hearings were chaired by the Secretary or Deputy Secretary, and were focused on regional energy issues. The second round of ten hearings was held in eight different cities around the country from December 1989 through February 1990. They were co-chaired by the Secretary or Deputy Secretary and eight other Cabinet or Agency officials, and were focused on specific energy topics. The DOE listened to 379 individual witnesses from 43 different states representing all regions of the country and all constituency groups concerned with energy policy. In addition, we have encouraged individuals to send their comments, concerns, and recommendations to DOE for review. To date, there have been over 1,000 written submissions which have been received and analyzed.

National Laboratories Participation in NES

To insure the best possible analytical support for the NES, the DOE has established a "committee of the National Laboratories." Membership includes the Assistant Laboratory Directors and members of the DOE NES Development Committee. In addition, DOE has commissioned the development of White Papers by the laboratories that will be used for discussion during the third round of hearings, tentatively scheduled for late

Spring/early Summer. These papers analyzed five specific issues:

- Energy Efficiency: How Far Can We Go?
- Global Climate Change
- The Potential of Renewable Energy
- Energy Technology for Developing Countries
- Energy Technology Transfer Process

Interagency Participation In NES

To facilitate interagency coordination and cabinet clearance of the NES, the Secretary of Treasury has established an Economic Policy Council Working Group. It is chaired by the DOE Deputy Secretary and includes 17 Cabinet and Agency members at the Assistant Secretary level.

OIL ISSUES

Oil studies addressed critical production factors affecting the long-term viability of the domestic industry. The costs and benefits of various financial incentives designed to encourage domestic oil and gas production were thoroughly analyzed. We assessed the impacts of exporting crude oil produced in the lower 48 states as part of a joint study conducted with the Department of Commerce and submitted to the Congress in January 1990. Potential export of heavy crude oil from California was a key element of this study. Our production capability studies feed into our ongoing analysis of the costs/benefits and national security aspects of the

Strategic Petroleum Reserve (SPR). The Policy Office significantly participated in the interagency studies of the size and alternative financing arrangements for the SPR. These reports were submitted to the Congress on February 2, 1990.

Environmental concerns associated with domestic oil production, refining, and end-use demand required close monitoring and analysis. Issues considered include: the EPA rulemaking lowering the volatility standards for gasoline; the potential for reformulated gasoline to play a significant role as an alternative transportation fuel; and the possible impacts of lower sulphur content in diesel fuel. In addition, the Policy Office provided the lead support to the Secretary's participation in the President's Outer Continental Shelf Leasing and Development Task Force. This Task Force analyzed the costs and benefits of petroleum development in three lease sale areas and submitted a report to the President in January 1990.

The Office assessed the potential for the transfer of American petroleum exploration and production technology to the Soviet oil and gas industry. This technology transfer is important for providing an opportunity to maintain the U.S. leadership in this technology. U.S. assistance also helps the Soviets maintain their contribution to world energy supplies and, thereby, reduce the international user community's dependence on Middle East oil producing countries.

To stay abreast of the interdependent international oil market, PE has refined and improved its world oil trade model that analyzes the effect of changes in crude oil and petroleum product supply, demand, and product specifications.

NATURAL GAS ISSUES

PE provided analysis to support the Administration's position on the Natural Gas Wellhead Decontrol Act of 1989. This Act, which was signed by the President in July 1989, will decontrol wellhead prices completely by January 1, 1993. In addition, the Office prepared the Department's current assessment of the natural gas industry and the role it can play in future energy and environmental policy.

The Office also provided the analysis for the Administration's proposal on oil pipeline deregulation that was submitted to the Congress on July 28, 1989.

ELECTRICITY ISSUES

The Office prepared an analysis of Title III of S.324, the National Energy Policy Act of 1989, that would amend the Public Utility Regulatory Policies Act of 1978 to encourage energy conservation and least-cost planning activities by electric and gas utilities. PE also prepared an analysis of S.406, "The Competitive Wholesale Electric Generation Act of 1989", that would amend the Public Utility Holding Company Act of 1935 and remove most of the Securities and Exchange Commission regulations over

independent power producers. In addition, the Office was responsible for preparing analyses in support of the Department's position on the proposed destruction of the Shoreham nuclear power plant. We also prepared comments to the Federal Energy Regulatory Commission (FERC) on a proposal filed by the Public Service Company of Indiana. This proposal would provide other utilities and electricity suppliers access to the Company's transmission facilities in return for FERC consent to sell the output from 450 megawatts of generation capacity at market-based rates. The Office analyzed proposed acid rain legislation and its effects upon electric utilities and the natural gas industry and initiated a joint U.S.-Mexico Study of increased electric bulk power trade and related cooperative ventures.

ENERGY EFFICIENCY ISSUES

PE provided analytical assessments in the areas of automobile fuel economy potential for foreign and domestic manufacturers, provided staff support necessary to establish the Interagency Commission on Alternative Motor Fuels and U.S. Council on Alternative Fuels as required by the Alternative Motor Fuels Act of 1988, prepared an assessment of oil conservation potential for inclusion in the IEA's work on energy and the environment, and initiated an IEA technical study "Energy Efficiency and its Potential Contribution to Environmental Goals." PE participated in the review of the Department of Transportation's Corporate Average Fuel Economy rulemaking, including analyses to estimate the relative impacts of gasoline

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prices and fuel economy on improving fuel efficiency. Several reports were published in this area, including "Energy Conservation Trends", which describes historic, current, and projected conservation gains in the U.S. economy, and "Energy Role in International Trade."

ENVIRONMENTAL ISSUES

PE is playing a significant role in the Intergovernmental Panel on Climate Change by supporting the working group on Impacts and Response Strategies. This year PE will complete three studies on global climate change issues requested by Congress. The fourth study will be completed in early FY 1991. The Office participated in international ministerial level conferences including the Noordwijk, Netherlands conferences on the atmosphere, and is providing support in planning for the Bergen, Norway conference on sustainable development.

PE sponsored three workshops with the University of California on climate change policy issues: (1) the effects of climate change on California, (2) policy responses to climate change, and (3) climate change and developing countries.

Protecting the Stratospheric Ozone Layers

PE participated as part of the U.S. delegation to the first meeting of the parties of the Montreal Protocol. Also, the Office participated in working groups to synthesize the assessment reports,

and identify/negotiate the appropriate amendment of the Montreal Protocol.

Transboundary Air Pollution

PE represented the DOE in the U.S. delegation to the Executive Body of the United Nations/Economic Community of Europe Convention on Long-Range Transport of Air Pollutants and participated in two working groups of the Executive Body on volatile organic compounds (VOC). We provided a technical basis and a protocol to limit VOC emissions on abatement strategies and developed a new international methodology for relating environmental impacts to national air pollutant emission levels.

PE led/participated in the U.S. delegations for the Organization for Economic Cooperative Development, Energy and Environment Group, International Energy Agency/Standing Long Term Group, and U.S.-Canadian bilateral meetings on a transboundary air pollution accord.

National Acid Precipitation Assessment Program (NAPAP)

The Office supported methods for the development of integrated assessment and analyzed a series of scenarios projecting national and regional emissions levels. We supported development of three state-of-science/technology monographs for the final NAPAP report and also supported studies in areas of

historic lake chemistry change, materials impacts, economic analysis, and emissions analysis.

Other Legislative/Regulatory Analysis

PE continued to analyze the energy industry impacts of reauthorization or codification of the Resource Conservation and Recovery Act, the Comprehensive Environmental Response, Compensation and Liability Act, the Clean Water Act, and the Safe Drinking Water Act. We participated on several interagency task forces charged with jointly producing reports to Congress or providing the EPA with guidance on waste classification and treatment practices in the petroleum and coal industries.

Indoor Air Quality (IAQ)

An update to the 1985 Indoor Air Quality Environmental Information Handbook "Combustion Sources" was completed. We continued development of an IAQ macro exposure model and participated in the Interagency Committee on Indoor Air Quality.

1991 BUDGET REQUEST

The FY 1991 budget request for PE is $9,301,000. This will permit PE to perform specific functions in areas critical to the continued development of national energy policy. It permits fulfillment of Congressional mandates and enables PE to continue its policy analysis and evaluation and program budget planning support to the Administration and the Department.

The FY 1991 request will also finance the continuation of policy initiatives which have been supported historically by the Department of Energy as a Cabinet-level agency: analysis of new energy initiatives by the Administration, analyses for the completion and implementation of the National Energy Strategy (NES), and preparation of associated energy projections are major FY 1991 priorities. To accomplish these tasks, the program support must accommodate four objectives: 1) provide data and technical expertise for policy formulation, 2) develop analytical tools which can be used to test the effects of energy policy on the economy, 3) provide analyses which will assist in the early identification of issues affecting energy markets, and 4) provide analyses that will support a planning, programming and budgeting system for integrating DOE program office plans with NES objectives.

The FY 1991 request includes funding for two primary program elements: policy studies and program direction. A breakdown is shown below.

BUDGET REQUEST

(BA in thousands)

	FY 1990 Funding Level	FY 1991 Request
Policy Studies	$4,198	$4,300
Program Direction	4,381	5,001
Total	$8,579	$9,301
Total FTEs	75	75

The request for policy studies is $4,300,000. This budget level will provide the means to undertake in-depth short- and long-term studies, and analyses of a discrete set of major policy issues. These studies are essential building blocks for the development of energy policy. In addition to short- and long-term studies, efforts will be directed toward continuous monitoring, analyzing, and forecasting of the Nations' energy production, supply, and markets.

PE's request for program direction is $5,001,000 which provides funding for salaries, benefits, training, and travel expenses to support 75 FTEs. The primary functions of the PE staff are: review, develop, analyze, integrate, and coordinate policy and budget planning options for the Secretary on the full range of energy issues and on single and multi-year program plans. Analyses typically are quantitative in nature,

focusing on macro- and micro-economic impacts of alternative policies on U.S. and world energy markets, and on the direction of the Department's short-, medium-, and long-term program plans. Substantial effort is made toward identifying emerging energy policy issues and the integration of program plans with budget objectives.

Mr. Chairman, this concludes my formal presentation. I would be happy to answer any questions you may have.

28-321 3088

Department of Energy
Washington, DC 20585

MARY JOY JAMESON

Mary Joy (MJ) Jameson was appointed Press Secretary of the Department of Energy in October 1989. She is also the Acting Director of Public Affairs and has responsibility for overall direction and management of that office. As Press Secretary, Ms. Jameson is the chief spokesperson for the Department and manages all Department Press activities.

Before coming to DOE, Ms. Jameson worked as a business consultant in Paris assisting U.S. companies setting up sales and marketing operations in France and French companies coming to the United States. From January 1988 until February 1989, Ms. Jameson developed and implemented marketing strategy for the Companige Fontaine de Paris, an economic development and international marketing firm.

From January 1985 through December 1987, Ms. Jameson served as the Special Assistant to U.S. Ambassador to France, Joe M. Rogers. She organized the visits of U.S. Government delegations to the French Capital.

Ms. Jameson was a Staff Assistant to the Northeast Regional Campaign Director for Reagan/Bush '84, coordinating fund-raising and press activities. Prior to that she served as the Chief of Staff and Press Secretary to Maureen Reagan from September 1983 - October 1984, coordinating all national and regional interviews and establishing the very first female-candidates support mechanism within the Republican National Committee.

In 1982, Ms. Jameson served as the Deputy Communications Director of the Republican National Committee, where her duties included assisting in overall communications planning and managing of the day-to-day activities. In 1981, she was an Assistant to the Director of Public Affairs for the Department of Energy.

A native of Ridgeland, South Carolina, Ms. Jameson was graduated from Clemson University with a BA in Political Science in 1977. Ms. Jameson currently resides in Old Town Alexandria, Virginia.

February 1990

Statement of Mary Joy Jameson
Acting Director of Public Affairs
Department of Energy
FY 1991 Appropriations Hearing

Mr. Chairman and Members of the Subcommittee:

I appreciate this opportunity to discuss the FY 1991 budget request for the Office Public Affairs.

The Office of Public Affairs, formerly part of the Office of Congressional, Intergovernmental and Public Affairs, has been spun off this year and is now its own entity. We conduct a wide range of press relations and public outreach activities. One of our primary responsibilities is to work with members of the national and regional press corps and to keep them informed about the many programs the Department of Energy undertakes. In addition, this Office provides public information activities that include departmental promotion and communications.

In FY 1991, the Office will continue to engage in the same types of outreach and liaison activities in which it has been involved in FY 1990. The budget request for the Office of Public Affairs for FY 1991 is $1,356,000. Our FY 1991 budget request calls for $1,314,000 for salaries and expenses and reduction of a personnel level to 22 Full-Time Equivalents (FTEs).

A total of $42,000 is requested for contractual support. These funds are necessary for transmitting news releases to major news bureaus; for the evaluation of audiovisual products and publications; and for the dissemination of consumer energy information through radio announcements and bi-monthly news columns.

Mr. Chairman, in response to this subcommittee's request, I'd like to give you an overview of some of our activities for the remainder of this fiscal year.

FY 1990 ACTIVITIES

For the balance of the fiscal year, this Office's mission will be focused on keeping the press and public informed on a number of important energy issues. These include:

- o developing a comprehensive National Energy Stategy;
- o making environment, health and safety issues the number one priority at all DOE facilities;
- o implementing the Department's Five Year Plan for environmental restoration and waste management;
- o carrying forward the decision plan for the opening of the Waste Isolation Pilot Project in New Mexico;

- o moving ahead on a new, restructured, comprehensive, and integrated research plan for determining a site for permanent disposal of civilian radioactive waste;
- o accelerating scientific research to better understand factors affecting global climate change and evaluating new policies and programs to reduce greenhouse gas emissions;
- o ensuring the modernization of the Nation's nuclear weapons complex;
- o restart of production reactors at DOE nuclear weapons facilities;
- o addressing the urgently needed improvement in science and math education.

The following table summarizes the FY 1990 funding level and the FY 1991 request:

	(Dollars in Thousands)	
	FY 1990	FY 1991
Salaries & Expenses...	$2,155	$1,314
Program Support.....	$ 266	$ 42
Total.....	**$2,421**	**$1,356**

Let me close by saying that we in the Office of Public Affairs looks forward to providing you with information on our programs and policies at DOE in an open and timely manner. Thank you.

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